

# Railway Mechanical Engineer

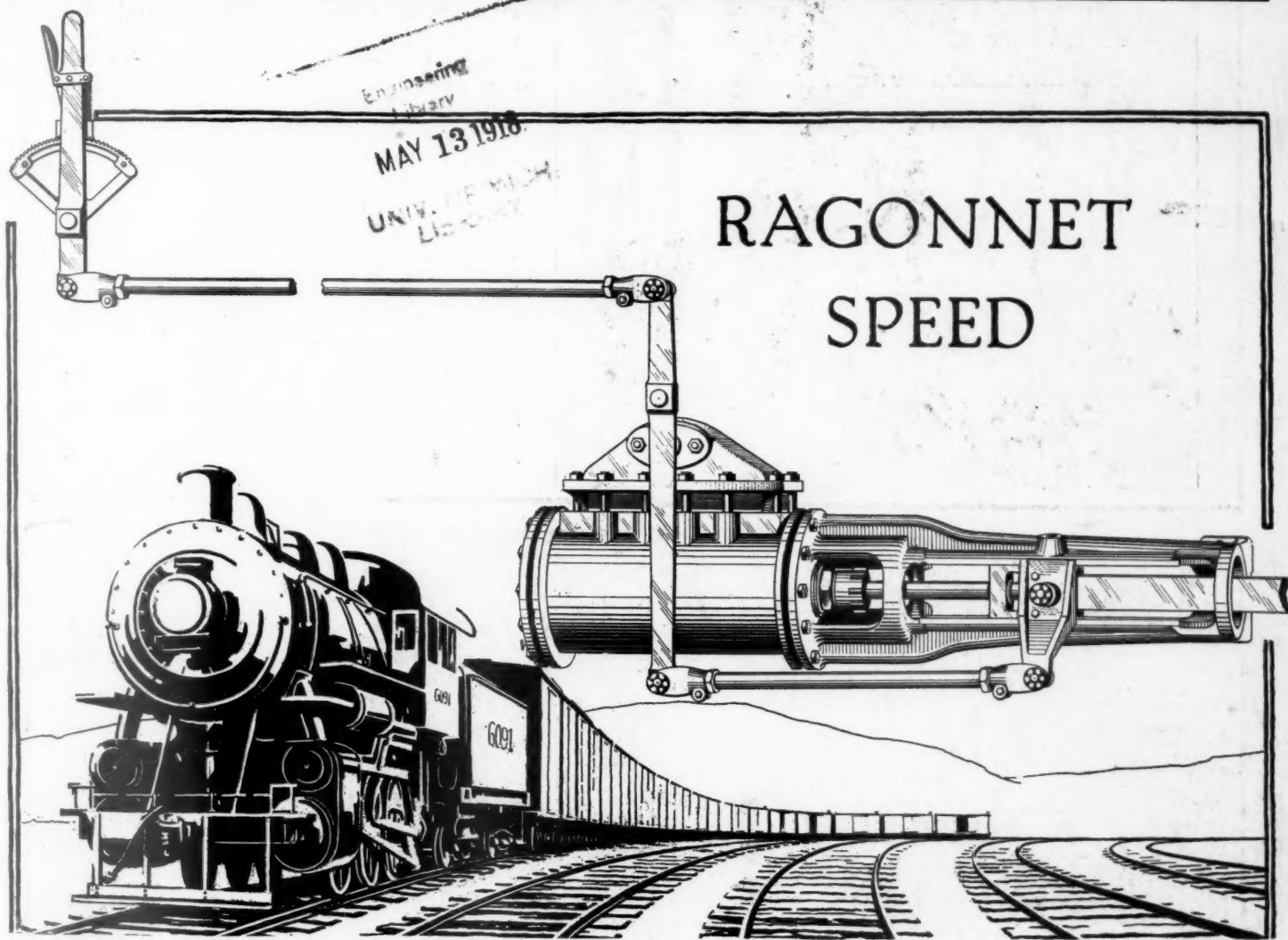
VOLUME 92, NUMBER 5

ESTABLISHED IN 1832

NEW YORK: Woolworth Building  
CHICAGO: Transportation Building

New York—MAY, 1918—Chicago

CLEVELAND: Citizens Building  
WASHINGTON: Home Life Bldg.



Five cuts of cars moved in the time it used to take to move four.

That's what RAGONNET SPEED means.

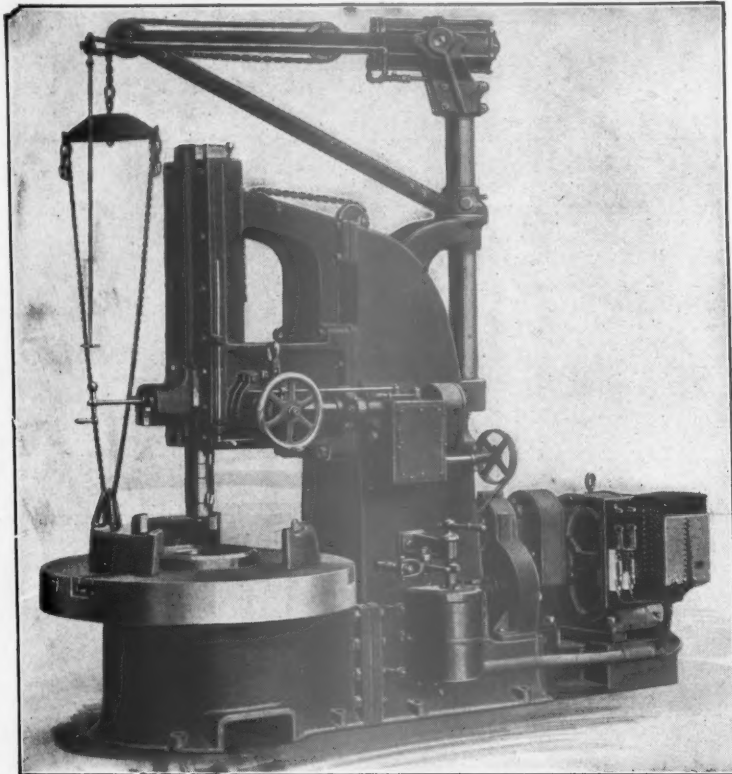
Many old engines have it.

The rest can get it before next winter by beginning your modernizing program now.

Franklin Railway Supply Company, Inc.

*William Sellers & Co. Incorp.*

Philadelphia, Pa.



## LABOR SAVING MACHINE TOOLS

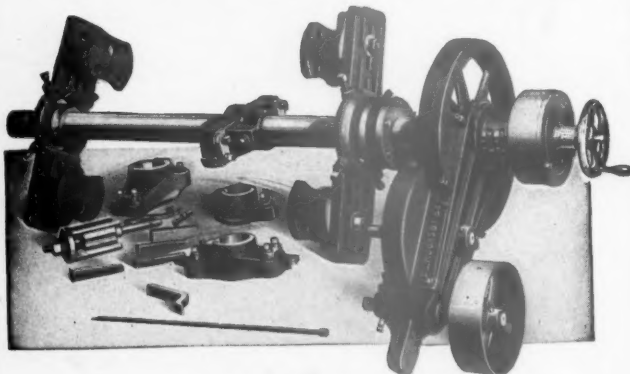
### The Sellers Car-Wheel Borer

automatically centers, chucks and unchucks wheel. Starting table closes chuck. Grip of chuck increases with pressure of cut. Reversing table opens chuck. Hoist handles wheels either side of machine. Hoist stops automatically at top and bottom of lift. Geared feed instantly changeable from roughing to finishing. Fully capable for maximum cuts and speeds required in modern practice. Easily and quickly handled.

**Hard labor of chucking, unchucking and handling wheels eliminated.**

**Locomotive Injectors & Valves  
Boiler Washers Safety Squirts  
Boiler Testers Strainers**

## ROOKSBY PORTABLE TOOLS FOR RAILWAY REPAIR SHOPS



PORTABLE BORING BAR

Boring Bars for Re-boring Locomotive Cylinders and Valve Chamber Bushings.

Crank Pin Machines for Truing Up Worn Crank Pins, New Design. Accurate work.

Portable Valve Seat Facing Machine.

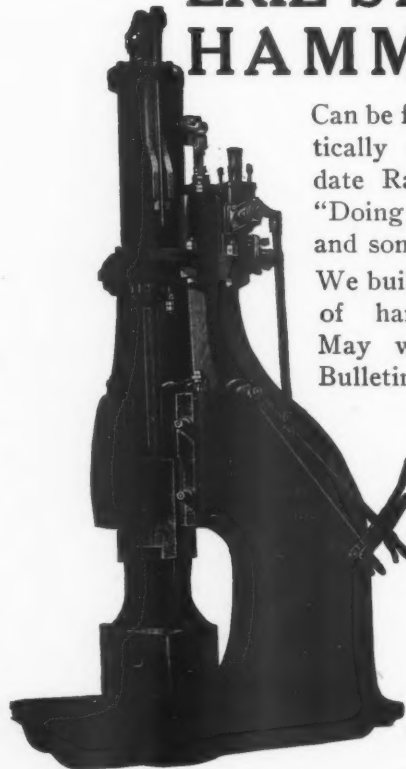
"Safety First" Requirements Satisfied. Send for Illustrated Bulletin "L"

**E. J. ROOKSBY & CO.**

1070 Hamilton St.

Philadelphia, Pa.

## ERIE STEAM HAMMERS



Can be found in practically every up-to-date Railroad Shop, "Doing Their Bit" and some more.

We build other types of hammers also. May we send you Bulletins?

**ERIE FOUNDRY COMPANY**  
ERIE PENNA.

# Railway Mechanical Engineer

Volume 92

May, 1918

No. 5

## CONTENTS

### EDITORIALS:

Doubling the Length of Runs.....	241
American Machine Tools in Australia.....	241
Freight Car Repair Problems.....	242
The Grinding of Car Wheels.....	242
Railroad Efficiency Depends on the Shops.....	242
Standard Locomotive Situation.....	243
Machine Tools Are Badly Needed.....	243
Keep the Cars in Good Condition.....	244

### GENERAL:

In Memoriam—Joseph W. Taylor.....	245
Standardization of Locomotives.....	246
A Yankee's Idea of French Engines.....	249
Status of Standard Locomotives.....	251
100 Per Cent Goal in Railroad Liberty Loan Campaign.....	254
Census Statistics of Railroad Repair Shops.....	255
The Dynamic Augment Problem.....	257
Air Supply to the Locomotive Firebox.....	260
Responsibilities of Railroad Men.....	260

### CAR DEPARTMENT:

Tabular Method for Calculating Moment of Inertia.....	261
Hopper Cars Built by E. J. & E.....	262
Should the Master Car Builder's Repair Card Be Abolished During the Period of the War.....	266
Standard Steel Sheathed Box Car.....	267
Freight Car and Tender Truck Bolsters.....	270

### SHOP PRACTICE:

Terminal Handling of Locomotives.....	275
Locomotive Fire Kindler.....	276
A Difficult Cylinder Weld.....	277

Handle Chisel Guard.....	278
Locomotive Side Play.....	278
Pneumatic Bench Clamp.....	279
Flue Setting.....	280
Effect of Bushing the High Pressure Cylinder of an 8½-Inch Cross Compound Compressor.....	280
Front Deck Brace.....	281
Ball Bearing Crank Pin.....	281
Prolonging the Life of Cutters in Davis Boring Bars.....	282
Cutting Tool Lubrication.....	282
Bench Drill.....	283
Indiscriminate Use of the Injector Causes Boilers to Leak.....	284
Reaming Tapered Holes to Standard Sizes.....	285
Home Made Pipe Bender.....	285
"Don'ts" for Apprentices and Others.....	286
Lubricating Oil Density.....	286
Side Rod Straps.....	287

### NEW DEVICES:

Power Hammer Attachment.....	288
Rod Lubrication.....	288
Treated Canvas Roofing for Steel Passenger Cars.....	289
Horizontal Bench Miller.....	289
Angle and Lead Testing Machine for Thread Gages.....	290
Wood Milling Machine.....	291

### GENERAL NEWS:

Notes.....	292
Meetings and Conventions.....	293
Personal Mention.....	294
Supply Trade Notes.....	296
Catalogues.....	298

#### Doubling the Length of Runs

One of the large items of expense which the mechanical department controls is the cost of handling locomotives at terminals. Efforts are constantly being made to reduce this expense, and to shorten the time the locomotive is held out of service. It is interesting to note that during the past few years some roads have attempted to eliminate the handling of locomotives entirely at certain terminals by running the engines over two divisions. These efforts have been fairly successful. They have resulted in appreciable savings in fuel and labor and have reduced the number of locomotives required to handle the traffic.

As a rule locomotives, when they arrive at the end of a run, do not have any mechanical defects that necessitate sending them to the roundhouse. The main difficulties met in trying to operate on long runs are due to bad coal causing clinkers in the firebed, or honeycomb on the flues, or bad water causing foaming. In many cases these troubles can be largely counteracted. Under the conditions existing in summer it is easier to lengthen the engine districts than it is in winter. There are no doubt a great many places where engines can be doubled through, at least during the summer season, if some special attention is given to the matter of reducing the trouble due to bad fuel or water. It is by no means impractical to clean the fires, and if necessary blow out the flues during a stop, and when foaming causes trouble, frequent blowing off, together with the use of anti-foaming boiler compound, will usually eliminate the difficulty.

The savings effected on one road by doubling the lengths of runs are reported as being more than \$75,000 a year.

Since 1915 this road has been running locomotives over two divisions on 34 runs, which aggregate 8,594 miles. The number of terminal handlings is reduced by 34 daily, thus saving 12,410 handlings in the course of a year. In addition to the saving of fuel and labor, there is a saving in motive power. The mileage per day made by locomotives on the divisions affected has increased 15 per cent, and it has been found possible to reduce the number of locomotives on the runs by 13 per cent.

#### American Machine Tools in Australia

"Among the imports from the United States during the last few years, machinery constitutes the largest item, and in the writer's opinion this will continue to be the case, particularly if there is a continuance of the present policy by which the railway departments manufacture and erect their own rolling stock and similar requirements. It is believed that in this line competent application engineering will be necessary in Australia and New Zealand to develop and hold the business for American products, though as a rule the railway officials are inclined to admit the superiority of most of the American machine tools." This paragraph in its few lines states what is probably one of the most salient facts in all the 164 pages of the report just issued by the Bureau of Foreign and Domestic Commerce as a result of an extended investigation by Commercial Agent Frank Rhea on American markets for railway materials, equipment and supplies in Australia and New Zealand. Mr. Rhea's report will be read with particular interest by ma-

chine tool manufacturers, because he spent some five months in Australia and speaks with the authority of one who has had many years' experience in both the railway and railway supply fields. But they will also want to peruse its pages because of the insistence he places on what he calls "application engineering" or on the importance of having representatives who see to it that any machines they sell are the ones best fitted for the work to be done, and who follow up the sale to assure themselves that the machine tool is giving entire satisfaction once it is in the shop. But the wealth of material as to Australian railway characteristics, methods of purchasing, and our opportunities there as given in the report should prove of inestimable value to other railway supply manufacturers, also. Australia and New Zealand are going to prove among our best export markets for railway supplies after the war. Inasmuch as export trade is one of the big problems of the day, the question can fairly be asked—and it is favorably answered in the report:—If the machine tool builders can do it, why can't manufacturers of other railway supplies do it also?

#### Freight Car Repair Problems

With the formation of the Car Repair Section of the Railroad Administration, with J. J. Tatum, formerly of the Baltimore & Ohio as manager, the maintenance of freight cars has been brought under centralized control as has the maintenance of locomotives. There is much good to be realized by bringing under one head this vastly important problem. It is believed that judiciously proportioning bad order cars amongst the roads will greatly relieve the bad order car situation. There is one very important fact that must be impressed upon every man in the various repair organizations, and that is—*the cars when once placed on the repair tracks should be put in A No. 1 condition regardless of ownership before they are allowed to get back into service.* This means even more than is outlined in Rule 1 of the M. C. B. interchange rules. It means that a "lick and a promise" will not do.

We understand that consideration is being given to the discontinuance of interbilling between roads for such repairs, as under government control and the unification of the roads there is no necessity for such practice. If this can be done without in any way causing a lack of care in making the repairs, it would seem to be a good thing. It will undoubtedly make necessary increased supervision and more rigid inspection. The effect such a plan would have on the car situation a few months hence is very apparent, and there is no reason why it cannot be successfully carried out if everyone will pitch in and do his work properly *regardless of the initials stenciled on the car.*

Every car man in the country will do much to relieve the bad order situation if he will get in and get under, and back the manager of the car repair section up to the limit.

#### The Grinding of Car Wheels

The question of the advisability of grinding car wheels in order to remove flat spots and reclaim the wheels for further service is a particularly vital one at the present time because of the need for increased wheel mileage. One of our readers has been inquiring about this practice and for the benefit of all we invite expressions of opinion from any who have had practical experience along this line.

Car wheel grinding was first tried a number of years ago, and since that time several railroads have installed equipment and grinding machines with gratifying results. One large western road in particular has been successful in grinding chilled cast iron wheels for some time and claims a big saving. A test of the equipment was made and in an

itemized cost statement which included charges for interest, depreciation, power required, grinding wheels and labor, the total cost of reclaiming one pair of wheels by grinding was shown to be less than sixty cents. At the time of this test the differential per pair of wheels, or difference between the new and scrap values, was more than six dollars, and the resultant saving was evident. There was also an additional saving which was hard to estimate in the decreased wear and tear on equipment due to the removal of flat spots and wheel eccentricities.

A grinding machine has been developed recently for shaping the wheel flanges, but it has not been in use long enough to demonstrate its value. Practically all of the grinding up to date has been done on the tread of the wheel. No attempt has been made to grind out flat spots over  $3\frac{1}{2}$  in. long, because in the case of chilled cast iron wheels it is not desirable materially to reduce the thickness of the chill.

New wheels often have a rough tread and are bored out and mounted eccentric with respect to the journal. This is almost sure to result in brake shoe gripping the wheel, causing slid flat spots before the wheels have made a thousand miles. In that case the scrap value of the wheel is saved, but half the new value is lost, plus the cost of machining, mounting on the axle, putting it under the car and taking it out again, to say nothing of the loss of service of the car in the meantime. We cannot afford such a wasteful practice in view of the present car shortage. The remedy for the above condition is to grind all cast iron car wheels before they are put into service as is the practice of one road.

But grinding is not entirely confined to cast iron car wheels. The same road previously referred to buys all of its Schoen steel wheels as they come from the rolls at three dollars less per wheel than if they were machined. The wheels are then bored, mounted and ground at a total saving of over \$5 per pair.

A consideration of the reports and data at hand indicates that car wheel grinding is a good thing and that the practice is being rapidly extended.

#### Railroad Efficiency Depends on the Shops

Anyone with roundhouse experience knows that there are certain locomotives that no engineer wants to run and no fireman wants to fire. Other engines are so popular with the roadmen that they will resort to all sorts of schemes in endeavoring to get them. Why is it that all locomotives of the same class do not give equally good performance on the road? The answer may be different in nearly every case but the general cause is probably minor variations in workmanship.

Some time ago one of a large number of locomotives was selected for a test. The roadmen declared the trial would be worthless because the engine was one which was called all the uncomplimentary names they could invent. When it was put on the road it surprised them by its splendid performance. The reason was that the shop men, when overhauling the locomotive prior to the test, discovered that the exhaust nozzle did not point to the exact center of the stack. They took unusual care to correct this defect with the result that the engine when turned out of the shop steamed freely and made a fine record.

Let us cite another instance to show the necessity for accuracy in shop work. A certain class of locomotives had very little clearance between the trailer wheel and the ashpan. Occasionally when a spring hanger broke the trailer tire would cut through the pan. The boiler maker foreman saw an easy way out of the difficulty and whenever he found the pan cut by the wheel, he raised it, placing it closer to the mudring. The result was that while the ashpan

was protected, the air inlet to the grates was reduced to such a point that proper combustion could not be secured.

No matter how well an engine steams, it cannot work economically unless the steam is distributed to the cylinders in the proper manner. Few railroad shops strive for extreme accuracy in the work of setting valves. A very slight variation in the dimensions of parts of the valve gear may result in an excessive consumption of steam and fuel. Since the railroads now spend more than \$4,000 annually for fuel for each locomotive they operate, and since poor valve setting may cause the fuel consumption to be 25 per cent greater than with the valves set properly, it can readily be seen that it is economical to spend a few dollars extra in the shops to do the work in the best manner possible and also to overhaul the valve motion in the roundhouse at frequent intervals with a view to keeping down the fuel consumption.

Most railroad shops have the apparatus required for properly balancing driving wheels, but in most places it is used only on rare occasions. A locomotive improperly counter-balanced is hard on the track and is uncomfortable to ride, to say nothing of the damage it does to its own machinery. An engineman can't be expected to take good care of a locomotive if the shop does not put it in condition to run without shaking him off the seat box and pounding out its own bearings.

The men who repair locomotives should bear in mind constantly the big part they play in securing efficient operation. Unless a locomotive is properly repaired it will waste fuel and thus add to the largest single item of expense the railroads bear. Unless it is an efficient and reliable machine, able to haul its tonnage over the division in a reasonable time without delays or engine failures, the transportation department cannot secure the maximum movement of traffic. A realization of the importance of the work in the shops should lead the men of the mechanical department to pay closer attention than they now do to those features of their work which are so essential to the economical operation of the railroad as a whole.

#### Standard Locomotive Situation

While the locomotive standardization committee's work has progressed to the extent that tentative specifications have been issued, it cannot be found

that the Railroad Administration has formulated any definite plans as to the extent to which the standard locomotives will be used. Impressions have gone abroad that the first orders for these locomotives will be sufficient to cover the demands for power that has been borrowed, thus permitting the borrowed locomotives to be returned to their home roads. Whether this plan is to be strictly followed remains to be seen. Unquestionably this would be the most practical limit to which standardization of locomotives should be carried.

As noted elsewhere in this issue, the tentative specifications were sent to the railroads with the request that the roads advise the director general of the number of standard locomotives they need to meet the requirements for this year. Following this, a memorandum was sent to various lines to the effect that if these standard locomotives did not meet the requirements, representation could be made as to the individual necessity for a departure from the standard types. This presents the matter in an indefinite sort of a way, and the interpretation to be made is open to question.

It is becoming rapidly apparent that unless something is done immediately, the output of locomotives for this year will not be up to maximum. In fact, G. A. Greenough said on April 15 before the Western Railway Club: "It is probable that the possibility of greater rapidity of construction has been lost for this year because of the length of time which the administration has required to give consideration

to the project (standard locomotives)." In its first report to Mr. McAdoo, dated February 19, the builders' committee stated that it would not be advisable to design standard locomotives without taking into consideration to the greatest possible degree the standards existing on the railroads at the present time and that "the proper execution of such a series of standard designs cannot be carried out in time to permit the building of any of these locomotives for 1918 delivery." The committee suggested further that if "this year's full capacity be utilized, the railways be permitted to order for quick delivery or until these standard designs can be worked out, such locomotives as they require, exact duplicates of those now in service on their lines." While it was realized that this condition would exist as far back as February, it is strange that no action has been taken to increase the output of locomotives this year. In our last month's issue we commented on the difficulties that would be experienced in maintaining standard locomotives in our already overtaxed shops. During the month Alba B. Johnson, president of the Baldwin Locomotive Works, in a paper before the United States Chamber of Commerce, which is printed elsewhere in this issue, took occasion to say: "Instead of simplifying the problem of locomotive maintenance, the introduction of government standards would complicate it." He also said: "The railroad manager who is responsible for his record of efficiency and economy should be permitted the widest discretion in selecting locomotives which he regards as best fitted for the conditions of service upon his line."

It is thus apparent that the builders as well as the railroad men realize the difficulties to be experienced with standard locomotives, and it is to be sincerely hoped that the Railroad Administration in making its final decision as to the extent to which standard locomotives will be used, will be governed by these arguments. But the fact remains that *whatever is finally deemed advisable by the Railroad Administration must be accepted by railway men the country over as the course it deems wise to pursue, and everyone must be a good soldier and make the most out of the situation, that this country may be victorious in the war.*

#### Machine Tools Are Badly Needed

The machine tool equipment of the average railroad shop is inadequate and makes efficient production impossible. The Master Mechanics' Association has repeatedly brought out the fact that better tools are needed in shops and roundhouses. The roads have not been able to secure the equipment because their revenues were inadequate and they did not have the money to spend for machine tools. The condition has been growing worse instead of better. During the years immediately preceding the European war, the roads spent on an average \$12,000,000 annually for shop machinery and tools. In 1915 they spent only \$9,000,000. For the past two years there has been a great demand for machine tools for war work, the prices have increased greatly and as a result the roads have confined their purchases principally to tools that were urgently needed. It is safe to say that the expenditures for tools have been smaller during the past two years than they were in 1915, and as practically nothing has been done to improve the facilities the shops are probably no better off now than they were two years ago, if indeed they are not in even worse condition.

Some shop men feel that with prices so high, the purchases should be restricted and that no tools should be bought except those that they cannot get along without. On the contrary, there never was a time when money invested in machine tools would bring larger returns. There is a serious shortage of skilled mechanics and the roads are finding it increasingly difficult to repair their equipment. Modern machine tools will increase the output per man,

and tend to counteract the labor shortage. The roads are now paying mechanics higher wages than ever before. They should provide these men with tools that are capable of high rates of production, in order to get a corresponding return for the wages they pay. In fact, this is practically the only way in which the large increases in the wages of mechanics can be offset. In 1915 the total compensation paid by the railroads to mechanics, helpers and apprentices, was over \$90,000,000. For the present year it will probably be 40 per cent higher or about \$125,000,000. Suppose that by providing better machine tools, the output per man for this class of workers could be increased by two per cent. If interest and depreciation is figured at the rate of 12 per cent annually, this saving would justify the expenditure of more than \$20,000,000.

Better machine tool equipment effects an important saving by cutting down delays to locomotives and by increasing the available supply of power. This is especially important in the roundhouse. The ordinary roundhouse machine shop is equipped with tools that have been used in the back shop until worn out and they should have been sent to the scrap pile. This is an economic mistake. Minutes lost in doing machine work in the roundhouse may result in costly delays. Under present operating conditions the roundhouse is often the neck of the bottle, and everything possible should be done to expedite the work of making running repairs.

Contrary to the opinion that seems to prevail among railroad men, nearly all classes of tools can now be secured within a reasonable time after the orders are placed. The requirements of the war industries seem to have been met, and conditions are becoming more nearly normal. While some special machines, such as wheel lathes and large planers, cannot be secured without considerable delay, a few of the smaller tools can be delivered from stock and most of the shop equipment which railroads use can be had within six months from the date ordered. Tools ordered now will be available in time to help keep the equipment in condition next winter.

With an acute shortage of labor the shops and roundhouses were in many cases unable to meet the demands made upon them last winter. Those occurrences will be overlooked because the conditions could be foreseen. It is certain that next winter will again test the capacity of our transportation system. The mechanical department is responsible for the condition of the equipment. If it is to do its full share in keeping up the efficiency of the roads it must have better facilities. Now is the time to decide what tools will increase the output of the shop, and to put in orders to make up in part for the small purchases of the last three years.

#### Keep the Cars in Good Condition

"During 30 days there have been over 200 cases of truck failures on our road," said the head of the car department of one of the large trunk lines recently. Speaking further of the condition of cars at the present time, he said that it seemed as if some roads are not doing all they should do maintain the trucks in good condition while cars are on their lines. There were many cases of arch bar trucks failing on account of nuts missing from oil box and column bolts. Many brake hanger bolts were found without cotters, split keys or nuts to hold them in place; others were worn half through. Brake beams had no safety devices to hold them up in case the pins or hangers should break. The road referred to is now giving particular attention to the condition of these parts. No car is allowed to leave the repair track until the trucks have been thoroughly inspected and put in good condition.

The unusual amount of trouble that is being experienced

due to these minor defects, is an indication that there is a growing tendency on the part of inspectors to pass by the minor defects. This is because of the fact that there is a great demand for cars and all the roads are trying to keep the maximum number in service. The car shortage this year has broken last year's records. For the past 18 months the demand for cars has exceeded the supply. The hard service has been wearing the cars out faster than ever before, and it has been difficult to get them to the repair track. The roadbed has deteriorated causing an increase in the amount of work on trucks. As a result of these conditions, derailments and wrecks have been more numerous in the past winter than ever before.

It is hardly necessary to point out that the standard of inspection must be maintained, regardless of the demand for cars. The car inspector's work is vital to the safe operation of trains, and he should never lose sight of the responsibility that rests upon him. He must not pass by defects that may cause accidents, hoping that no harm will come of them. In spite of all precautions there will be occasional equipment failures. Even a slight defect, intentionally neglected, may cause serious damage or even loss of life.

Beyond doubt the car repair forces will have a difficult task trying to keep the equipment in good condition during the present year. Although the statistics show that the number of cars in shop or awaiting shop is no greater at this time, than for the corresponding period last year, there is no question that the general condition of equipment is constantly growing worse. Practically none of the roads has been able to keep a full force of car repairers because the higher wages paid in other lines of work has drawn the men away from the railroads. There seems to be little prospect that labor conditions will improve, although it may be that the Railroad Wage Commission will make adjustments in the rates of pay that will put the car department in a more favorable position. The material situation shows some improvement and there will probably be little difficulty in securing either wood or steel this year.

One of the conditions that will make it hard to keep up the output of the repair track is the increasing percentage of foreign cars on all lines. With the unrestricted routing of cars more and more will find their way off the home line, and since no improvement can be anticipated every road must arrange to give the same attention to all cars regardless of ownership and must attempt to keep up the normal output of the repair track, even though the men are working on equipment with which they are not familiar. The painting is being neglected. Unless this is attended to promptly the deterioration of cars is sure to be repaid. All roads should arrange to repaint foreign cars as well as their own, in order to forestall the depreciation of equipment. Every repair track should keep a full force employed and should arrange to put every car that passes over it in good shape regardless of the ownership.

There are some who advocate the suspension of the M. C. B. rules for the period of the war, on the grounds that it would expedite the movement of cars. This is a radical proposal, and it seems that those who make it have overlooked the fact that the principal function of the M. C. B. rules is to insure that safe practices are followed in the construction, repair and operation of cars. The interchange of repair cards may be done away with while the roads are under government control, but all regulations that make for safe operation should be retained. The car situation will not be improved by radical measures. The equipment can be kept up if the roads are given assistance in securing an adequate supply of labor and material and if everyone in the car department works with a patriotic spirit to serve not merely the railroads, but the country whose commerce they carry—the country whose interests we all have at heart.

# IN MEMORIAM—JOSEPH W. TAYLOR

Secretary of the Railway Mechanical Associations  
and the Western Railway Club Dies Very Suddenly

ONE of the most widely known and best liked men in railway mechanical circles has passed away. Joseph W. Taylor, for many years secretary of the American Railway Master Mechanics' Association, the Master Car Builders' Association and the Western Railway Club, died at his home, 4102 Calumet Avenue, Chicago, on the morning of April 24. Organic heart disease was responsible for Mr. Taylor's sudden death. He had been at his desk the day before he died, and was apparently in good health. Mr. Taylor was known to everyone who attended the meetings of the Master Car Builders and Master Mechanics' Associations, through his long connection with those organizations. Previous to the time when he took over the work as secretary, he acted as secretary to John W. Cloud, who formerly held those offices. Even before assuming the position which he occupied up to the time of his death, Mr. Taylor was a familiar figure at the conventions held at Saratoga and Old Point Comfort. As assistant to Mr. Cloud he took an active part in the preparation of proceedings of the Master Car Builders' and Master Mechanics' Associations. In 1899 Mr. Cloud went to London to take charge of the British office of the Westinghouse Air Brake Company and in June of that year Mr. Taylor was appointed secretary of both associations. His appointment as secretary of the Western Railway Club followed in October, 1899.

William Schlafge, president of the Master Mechanics Association, says in commemoration of Mr. Taylor:

"The news of the death of Joseph W. Taylor will be received as a distinct shock to many friends and acquaintances throughout the country.

"During the twenty years of Mr. Taylor's services as secretary to the railroad mechanical associations his uniform and unfailing courtesy have won the very high regard and esteem of the many executive officers of the associations not only, but of the hundreds of members who have had occasion to seek his counsel in the routine of association activities.

"The sympathy of the entire railroad mechanical world will be extended Mr. Taylor's family in their bereavement which is particularly distressing in view of Mrs. Taylor's impaired state of health."

A. R. Kipp, president of the Western Railway Club, in a note of appreciation says: "The sudden death of Joseph W. Taylor was a great shock to me. Notice of it came to me at Minneapolis at the same hour in which I received a pencil note from him written the day before. Joe Taylor

will be missed by many men in railroad circles and nowhere will he be missed more than by members of the Western Railway Club who have seen him for so many years performing faithfully his duties as secretary at its meetings. Few railroad men there are who did not know him personally or at least by reputation through his position as secretary of the various mechanical organizations. It is characteristic of his faithfulness that he died in the harness."

Joseph W. Taylor was born in Saltsburg, Pa., on March 9, 1862. He entered railway service early in life on the Erie railroad and was for a time a locomotive fireman. Later he became associated with the Westinghouse Air Brake Company at Chicago, but gave up his position to devote his entire time to his duties as secretary of the M. M. and M. C. B. associations. For the last 19 years Mr. Taylor has been secretary of these associations and also of the Western Railway club. During the entire time he has taken a prominent part in the work of these organizations. Throughout his long tenure of these offices, Mr. Taylor discharged his duties in a thorough, efficient and most trustworthy manner. He never betrayed the confidence of his position. The reports and proceedings which he edited were always models of correctness. As Mr. Taylor has had no assistant in the work, it will be a difficult matter to find a man to fill his place.

At the 1910 conventions a tribute was paid to Mr. Taylor through the columns of

the Railway Age Gazette which so clearly shows how much he was appreciated that it is reprinted here:

"When John W. Cloud—known as the 'ideal' secretary of the Master Car Builders' Association for many years and of the Master Mechanics' Association for a shorter period—in 1899, resigned to accept the representation of the Westinghouse Air Brake Company in London, many doubts were expressed as to the possibility on the part of either or both associations of finding a successor whose work would be even a passable substitute for that to which they were accustomed. Wisely, however, as it appeared then and as it has appeared with double force every year since, it was determined that the safest course lay in the selection of one who had had the benefit of Mr. Cloud's training and who, in fact, had done the principal part of the detail office work as Mr. Cloud's assistant. Notwithstanding that the duties of the office have very largely increased by reason of the increased membership and volume of work done by both associations—a fact only partially shown by the growth



Joseph W. Taylor

in size of the volumes of proceedings—Joe, as he is almost universally called, has never found the job too big, nor has he failed to come to time when any ordinary or extraordinary demand has been made upon him. Unquestionably and by right of faithful and intelligent work the mantle of the 'ideal' secretary now rests upon Mr. Taylor's shoulders.

With few exceptions probably the members of neither association appreciate the volume of work which the secretary is called upon to perform between one year's convention and the next. It is an ever-continuing job, though the culmination of its activities is naturally in the period a few months before and a few months after the conventions. The office is the focus of all the movements of both associations. It is the medium through which hastily prepared and sometimes ill-digested plans of a few members are filtered before they come to the attention of the associations as a whole or to the public. The secretary is not only the recorder, accountant and editor; he is in a most unobtrusive and unrecognized way a 'whipper-in' and adviser to all the members, the effectiveness of this persuasion and the acceptability of this advice consisting precisely in this unobtrusiveness and lack of recognition.

"Joe Taylor has been secretary of these two associations and of the Western Railway Club so long that it is hardly worth while to recall what he was before, except as Mr.

Cloud's assistant. He is generally credited with having held down a chief clerkship on the Erie before he went to Chicago; but it doesn't matter. He has made himself and he has made the secretaryship of three important railway organizations—all of them jobs worth bragging about. But 'Joe' never does that and that is why his newspaper friends have to step in—like this."

Mr. Taylor's personal characteristics endeared him to his large circle of acquaintances. Straightforward and open in his manner, sympathetic and always ready to lend assistance, he went about it in a quiet way aiding many without the knowledge even of his intimate friends. He was intensely patriotic and had taken active interest in the Liberty Loan campaigns. Mr. Taylor took a prominent part in the work of fraternal organizations and was a 32nd Degree Mason.

His funeral was held at Chicago on Saturday under the auspices of the Knights Templar. Representatives of the Master Car Builders' Association and Master Mechanics' Association and the Western Railway Club were present, as well as many of Mr. Taylor's personal friends and associates. Mr. Taylor is survived by a brother; a son, Joseph W. Taylor, Jr., of El Paso, Texas, and his widow who is in very delicate health and on that account has resided in Texas with her son for several years past.

## STANDARDIZATION OF LOCOMOTIVES

Its Possible Effects on Transportation Discussed  
by Two Officers of the Baldwin Locomotive Works

THE effects of the application of a policy of general standardization of locomotives to American railways was discussed by Alba B. Johnson, president of the Baldwin Locomotive Works in a paper on the Railroad Administration's Motive Power Problems, which was presented on April 11, before the United States Chamber of Commerce at the annual meeting held in Chicago. At the meeting of the Western Railway Club, held in Chicago on April 15, Grafton Greenough, vice-president of the Baldwin Locomotive Works, also took occasion to discuss the same subject in a paper on Economy in Maintenance and Operation of Locomotives.

### ALBA B. JOHNSON'S PAPER

Mr. Johnson's paper briefly sketched the history of the development of the locomotive, from the time of the Rain-hill trials on the Liverpool & Manchester, in 1829, which demonstrated the practicability of Stephenson's "Rocket," showing the rapid strides in growth and development which have taken place in the intervening 89 years. An abstract of the portion of the paper dealing with standardization follows:

Standardization has been an ideal much talked of but never realized in actual practice, because standardization implies the crystallization of present practice as the practice of the future, and means that no further changes shall be made as the result of experience or invention. Carried to its logical extreme, the adoption of inflexible standards at any time during the history of locomotive development would have involved the stoppage of progress at that point. Many attempts have been made to fix standards for particular railroads and groups of roads, but in every instance these have given way to the urgency of keeping pace with other roads which have not attempted to bind themselves with the iron bands of standardization. The practical result of such attempts has been that those lines most

rigidly adhering to their standards have lagged behind their competitors.

The result of more than eighty years of experience has convinced railroad men that the most advantageous field for standardization is in details rather than in the complete locomotive or car as a unit. Most of the advantages sought through standardization have been obtained by unifying or standardizing the design of various parts common to a considerable number of classes. Whilst the American Railway Master Mechanics' Association and the Master Car Builders' Association have perhaps accomplished less in procuring the adoption of complete standard units than advocates of standardization would have liked to see, they have done splendid service to the transportation interests of the country by the adoption of the numerous standard details, by their discussions and by their interchange of experiences. It may be said that their accomplishments have been as great as it was humanly possible to achieve under the conditions of diversity of managements, diversity of ideas and the necessity of constantly keeping abreast of the march of improvement. American railroad men need have no fear of comparison with other countries, either in the practical common sense which has been shown in the conservative encouragement given to improvements in engineering practice, or in the reductions which have been achieved in the cost of transportation.

### WAR BRINGS NEW CONDITIONS

The participation of the United States in the world-war has brought about new conditions. For the first time it became practicable to adopt and to enforce standards to a large extent. The very forces of competition had brought about a uniformity of general dimensions and weights of locomotives for trunk line service. Inasmuch as all kinds of cars were being hauled indiscriminately over all railroad lines, there could be no reason why a diversity of details

should exist amongst those belonging to different railroads. To a lesser degree, perhaps, these considerations apply also to motive power. If one type of locomotive could haul a given train across the continent to the west bank of the Mississippi river, there appeared to be no adequate reason why a locomotive of different type or different details should be required to haul the same train from the east bank where the grades and working conditions were not too divergent.

In the early days of railroading it was quite common for the same line to have different types of locomotives to haul its trains over different divisions of the road. The same conditions now exist upon a larger scale. Notwithstanding a certain amount of standardization of the locomotives on each road, there is a large diversity amongst different roads having practically the same operating conditions. The opportunity given to the director general of railways to unify the motive power of all railroads, was unique, and the conception a fascinating one. The work of preparing standard specifications and drawings was entrusted to a committee comprising eleven railroad officials who collaborated with representatives of the three principal locomotive builders. As the result of their diligent and continued work, twelve standard specifications have been agreed upon and their final approval is at the present time under consideration.

No one railroad will be compelled to order all of these 12 standards; even the largest trunk lines may find half that number sufficient.

#### EXTENT TO WHICH STANDARDIZATION SHOULD BE CARRIED

A delicate and interesting question of policy is to what extent these standards should be confined to the essential elements of the locomotive, and to what extent they should be confined to its accessories. The committee wisely adopted the principle of defining only the essential locomotive, leaving a certain freedom to the railroads to maintain their standard accessories, and a certain freedom of competition among manufacturers of railway equipment. It must be borne in mind that the railway equipment business itself is a most important one, embodying as it does several hundred separate manufacturers, with invested capital running into the hundreds of millions and employing several hundred thousand men. These separate manufacturers have studied incessantly to improve their appliances and to reduce their costs.

Their productions are of two classes, first, those materials or devices which have become essential parts of locomotives, such as air brakes, tires, headlights, injectors, steam gages, etc., etc.; and second, those which are not strictly essential to locomotive operation but which contribute to efficiency and economy. Amongst the latter are such things as mechanical stokers, superheaters, feed water heaters, power reverse gears, etc. These devices are constantly shifting from the second to the first class. Most of those now universally conceded to be in the first class were at one time probationary. Many of those now rated in the second class are rapidly achieving recognition as essentials to be regarded as in the first class. To carry standardization to its extreme limit would involve a determination of the most desirable among many competing devices, and would destroy the market for all the others and throw their makers out of business. It would check the transfer into the first class of those items enumerated as of the second class and would also paralyze every effort toward the invention and introduction of new improvements.

The committee has wisely refrained from attempting a solution of these problems, and its further course with respect to them is yet to be ascertained. Some policy must eventually be adopted, however, either of leaving the railroads which are to receive and operate the standard loco-

motives, latitude to designate such specialties as in their experience have proved worthy of adoption, or for the director general of railways, through his advisers, to make a selection. The former would appear to be in every way the wiser course.

#### THE USE OF STANDARD LOCOMOTIVES WILL COMPLICATE REPAIR PROBLEMS

I have stated above that the standard specifications have been recommended for approval. They have not yet been finally adopted, as a strong plea is made on behalf of the railroads similar in principle to that applicable to locomotive accessories, that each railroad should be allowed to continue to adhere to the standards already adopted. The choice of course involves the weighing of the respective advantages. It may be said for the railroads' contention, that under normal conditions locomotives are not shifted from one road to another, but are generally used continuously upon the same division to keep the traffic movement balanced, and are kept in repair continuously by the same shops. These shops are supplied with standard repair parts and the workmen are proficient in maintaining the repairs of these existing standard locomotives. To introduce a new government standard upon all lines as an entirely clean proposition would be simple enough, but to introduce it on lines and conditions affecting an entire continent and already equipped is quite a different problem. It necessarily compels all lines to provide themselves with stores of repair parts adapted to the government standard locomotives. Thus, instead of simplifying the problem of locomotive maintenance, the introduction of government standards would complicate it. These complications would last far beyond the period of government control and would continue as long as the railroad standard and the government standard locomotives operated side by side upon the same lines.

#### LET RAILROAD MANAGERS CHOOSE LOCOMOTIVES BEST SUITED TO THEIR CONDITIONS

It may be said that the workman who is responsible for the best workmanship, should be entitled to the selection of his own tools, and similarly, that the railroad manager who is responsible for his record of efficiency and economy, should be permitted the widest discretion in selecting locomotives which he regards as best fitted for the conditions of service upon his line. If, however, it should be urged that the advantages of standardization to which the roads can work, would in the long run be sufficient to compensate for the disadvantages of present increased confusion, then some principle must be discovered by which standardization shall avoid the cessation, if not the extinction of improvements. Every improvement in some sense involves the destruction of standardization. It would be an evil day for American engineering and for American progress in the art of transportation, which would involve a policy of discouragement to new and useful improvements in the art. We should therefore look carefully before we leap, to make sure that we are not giving up the substance of continued growth in efficiency and economy, to grasp the chimera of standardization. Especially should this be considered most carefully when the world-wide danger of this war is upon us.

#### MONEY FOR IMPROVEMENTS RESTRICTED

The motive power of the country is admittedly inadequate to the service demanded of it under the present war conditions. During the depression preceding the war there was a small surplus of power which, as should have been foreseen, would be absorbed in traffic with the first increase of activity. As a rule, railroads have purchased locomotives largely under the spur of excessive traffic and have ab-

stained from purchasing during periods of reduced earnings. This is contrary to the economics of the situation. Enlargements of facilities should be made in times of depression, because, first, that is the cheapest time to do it; second, it is the most convenient time to do it; and third, it is the time when the managers can give most attention to doing it and fourth, the employment of labor arising out of large railway purchases tends to mitigate the severity of a general depression. The reason the railroads have not done this since 1907 is, that under the regulatory policy which went into effect at that time, railway managers have not been able to accumulate surpluses sufficient in their judgment to warrant bold construction in times of small earnings, and especially because future earnings have not been susceptible of approximate calculation even where the volume of traffic could be estimated in advance. Adequate provision of motive power, like adequate provision of other rolling-stock and other facilities, can only be assured when Congress places upon the functionary charged with the duty of regulating rates, the definite responsibility of making such rates as will yield earnings sufficient for thorough maintenance, for adequate improvements and sufficient to attract the capital necessary for providing additions and extensions.

#### GRAFTON GREENOUGH ON STANDARDIZATION

In his paper read before the Western Railway Club, on April 15, Mr. Greenough discussed the locomotive standardization problem as follows:

The recent change in the controlling power of railroads has brought about the possibility of experimenting along lines which have long been under contemplation, but have been deemed outside the realms of the possible. I refer to the proposed standardization of the locomotive as a unit. The railroad administration, primarily to reduce the first cost of locomotives and with a view to effecting an interchangeability in repair parts which would enable locomotives to be transferred conveniently from one section of the country where transportation might reach a low ebb to another more congested district, has through conferences with the builders and the railroad committee proposed to bring about a series of standard locomotives. The committees appointed have done their work efficiently and there are under consideration twelve designs of locomotives, in some cases two of a single class, one heavy and one light.

The arguments in favor of such standardization are interchangeability between railroads, the possibility of some rapidity of construction, interchangeability of repairs and a somewhat lower cost. It is probable that the possibility of greater rapidity of construction has been lost for this year, because of the length of time which the administration has required to give consideration to the project. We could doubtless have built a larger number of locomotives, exact duplicates of those now on the railroads, had orders been placed two months ago, in a shorter time than we will be able to build the new types of locomotives, details concerning which are not yet settled.

The arguments against standardization may be summed up as follows: The capacities of the locomotives are based upon average conditions; hence there is no provision for the extreme requirements which these locomotives do not cover. Where even the light locomotives are too heavy for service and where the heavy locomotives are not of sufficient capacity special locomotives will have to be provided unless those requiring lighter engines purchase from other roads discarded power, and those requiring the heavier locomotives change their system of operation so as to use the heavy standard government locomotive. In such instances where railroads have been equipped from one end to the other to use power of maximum capacity for the purpose of reducing train movements this would prove a negative economy.

The standard locomotives are designed for bituminous

coal fuel and radical changes in their construction will be required for burning anthracite or an appreciable percentage of anthracite or for properly burning pulverized fuel. Oil fortunately requires no basic change. The limiting sizes of the locomotives of length, height and width must necessarily conform to the minimum to be found on the various roads over which the locomotives are designed to operate. These restrictions necessarily cramp the designs and limit their efficiency to the restrictions of the fuel. A limit of height of 15 feet has been proposed for all except the heavy Santa Fe and consolidation Mallet type locomotives; consequently steam space, domes and smoke stacks are mere shadows of what they would naturally be. In a country as large as ours various physical and climatic conditions exist which the proposed standardization ignores; consequently the locomotives will afford maximum efficiency in some localities with a corresponding loss in others.

No standardization of this extent has been dreamed of in the past; hence the task is relatively momentous. The Pennsylvania has for years given serious consideration and effort to the standardization of their equipment; likewise the Harriman Lines in 1905 proposed a series of standard locomotives for all roads controlled by them. Both of these efforts have resulted in an extensive standardization of parts, but not in a complete standardization of equipment, because growing needs for larger and more efficient power and the improvements in the permanent way have invited and made possible increases in the size and capacity of locomotives which have thrown to the winds any idea of standardization of locomotives which would extend over an appreciable period of time. In both instances the standard locomotives of today bear no comparison to the standard locomotives of ten years ago. The conservation of our resources will not permit of a system of standardization which is so inflexible as to choke further improvements and thus discourage the inventions which may now be in their incipency. Yet how can we maintain a standard which is permitted to change, and how can we progress without change. If standardization of locomotives as units is a war measure; if it will help us win, let us have standardization quickly and regard it as a war measure but if it is an economic experiment the final net result may be the addition of just so many classes of locomotives to those now existing.

The ideal standardization provides for the elimination of unnecessary diversity and progress invites and necessitates diversity, hence in spite of our ideals the standardization of locomotives may be limited to the standardization of the maximum number of parts.

The problem now before the administration is to decide whether or not the criticisms in favor outweigh those against the proposed standardization, and we all await the decision with the keenest interest, and we all hope the decision, whatever it may be, will prove for the best.

---

MORE DESTROYERS THAN THERE ARE NOW IN THE WORLD.—E. G. Grace, president of the Bethlehem Steel Corporation, told the 500 guests of the Allentown, Pa., Chamber of Commerce at its banquet on December 20, that the submarine destroyers which the Bethlehem Shipbuilding Corporation will build for the government are more than all of the destroyers now in the world. Mr. Grace said he regarded the rapid construction of destroyers as the solution of the submarine menace. Mr. Grace said that of the entire ship construction of the United States, war vessels and merchantmen included, the companies of the Bethlehem Steel Corporation are bearing more than half of the burden. The Bethlehem plants now employ 30,000 men as compared with 9,000 five years ago. Charles M. Schwab, who also spoke, said that the payroll of the Bethlehem plants is now \$100,000,000 a year.—*Iron Age*.

# A YANKEE'S IDEA OF FRENCH ENGINES

Letters from a Santa Fe Boy Describing the Motive Power and the Troubles Experienced in Maintaining It

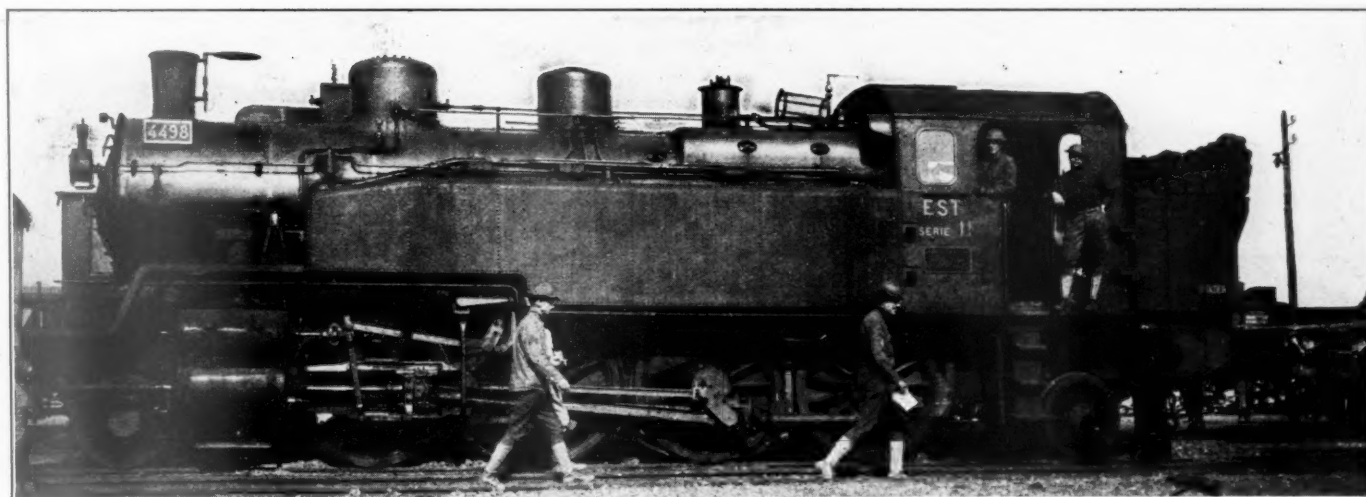
THE censorship of correspondence has made it difficult to get news from the American Railway Regiments, nevertheless many interesting letters have been received telling of the work that is being done. The letters below and the illustrations accompanying them were sent by a member of one of the shop regiments, Sergeant G. T. Foster of Company F, Thirteenth Engineers, and are published through the courtesy of the Santa Fe Magazine. Referring to the French locomotives, Sergeant Foster writes:

"The photograph of engine No. 3544 shows a typical French locomotive used in passenger service. The cab is peculiar, affording poor protection in severe weather. It has no sliding windows or deck curtain, and is built with front doors and also the front cab wall diagonal, to break the wind at high speed. The cab door is an excellent idea, aside from the wind-breaking feature, because it gives more room for an average sized engineer to pass from the cab to the running board. The cab floor also projects a few inches outside the cab so that a large sized engineer can easily pass

dome, in which case it takes an entire book to describe it. More often it is located in the small box ahead of the sand dome, running clear through it with a gland and stuffing box on the front and back sides of this box.

"In this locomotive the throttle valve is inside the steam dome, with one stuffing box in front of the small box and another out on the rear of the throttle dome. The main dome and small throttle box are integral in this case, and the movement of the throttle rod is not a pull in a horizontal direction, as in the States, but is a twisting movement similar to opening and closing a globe valve. The throttle valve moves across its seat similar to the movement of the valve in the old Johnson blow-off cocks, only in this case the throttle valve is much larger than a blow-off valve and rectangular in shape, moving over a ported seat.

"The smokestack has a lid which is used when the engines are standing, to protect the flues. The headlight burns oil and is very small. Below the running board you can see the high-pressure cylinders and D-slide valve chest. You can



American Boys Railroading in France

from the gangway to the running board without entering the cab.

"About the roof of the cab can be seen the levers of the pop valves. The firebox, of course, is of the Belpaire type, with copper sidesheets and staybolts. Along the side of the boiler can be seen the air pump, which is simple on the steam end and tandem compound on the air end. About the only United States air equipment on this engine is a Westinghouse pump governor.

"Along the side of the firebox and also along the barrel of the boiler can be seen three rectangular oil boxes, from which oil pipes run down to the driving boxes, so that the engineer can oil the shoes, wedges and cellars while he is up on the running board. This is an excellent idea. The sandbox is immediately ahead of the firebox on the boiler. Air sanders are used. No special mention need be made of this feature excepting that the steps up to the sand dome are very convenient and safe. The auxiliary steam dome is inside the cab. The main dome is immediately ahead of the sand dome, with the throttle rod passing through it and into the small rectangular box immediately ahead of the main dome. The throttle valve is sometimes located inside the main

also see the piston rod extension and the Walschaert valve gear to the high-pressure cylinders. The steam pipes run outside the boiler from the throttle box to the high-pressure cylinder. The boiler check is just ahead of the steam pipes and is very small. Over the engine truck you can see one of the main reservoirs bolted to the running board. The main frames, as well as the tender and engine truck frames, are of heavy steel plate construction. The engine truck is equipped with air brakes.

"The tank shows the briquettes of coal piled on top. At the front of the tank and about a foot back of the gangway can be seen three plug valves, or cocks, which indicate the height of water in the tank. This is a very handy thing for the engineer. Above the top of the throttle box can be seen an oiler for pouring oil in a cup and feeding direct to the cylinders in case the lubricator goes to the bad. They get very poor valve oil over here, and the lubricator and tallow pipes are easily stopped up. Their superheater valve oil, however, is excellent and does not give this trouble.

"The other photograph, of engine No. 4498, shows a saddle tank locomotive of very good design. The coal tank, with the usual briquette coal, is shown plainly at the back

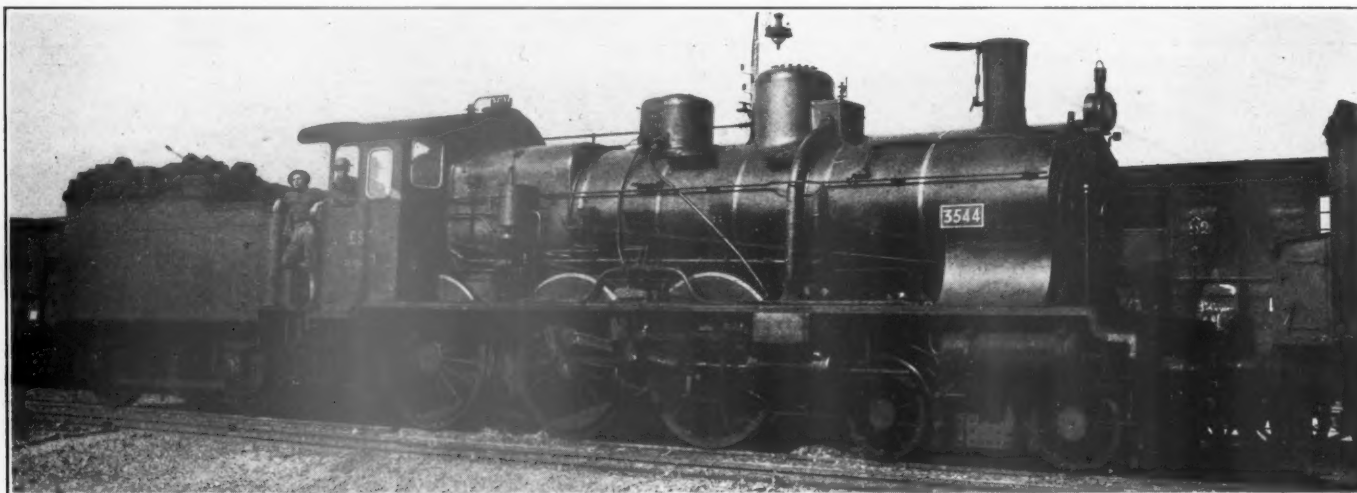
of the cab, which is a good stormproof cab compared with most French cabs. The water tanks are carried along the running boards, so one does not have to worry about the federal boiler inspectors finding broken staybolts. The wash-out plugs over here are really hand-hole plates like those used in stationary practice in the States. Two of these are shown at the radius of the Belpaire wrapper sheet. Just ahead of the cab, on top of the boiler, can be seen a tank strainer which looks like a minnow bucket. The water goes through this strainer when the engine takes water at the water crane.

"Just ahead of the water tank along the running board can be seen a ratchet jack of about twenty tons capacity. All engines carry one of these. They are traverse jacks, the idea being to use four of these when an engine is derailed, under the four bearing corners of the locomotive. The engine is elevated and then traversed back to correct alinement and lowered to the rails. After rerailling several locomotives one would trade all his worldly goods for some good old American frogs.

"This engine has a Mikado wheel arrangement, simple cylinders, piston valves, extension piston rods and a superheater. The blower valve is on the outside of the main dome, with a valve stem running clear back to the cab. The

it's hard to run an engine in the rain, especially with poor headlights. Of course, putting in cylinder packing and reducing rod brasses is no joke either, out in the rain and snow. Some of our engines are very awkward to work on. When we have to use rope asbestos to pack steam leaks on engines and when we have to kill the engine to pack almost every valve, it's no joke. Then the valves are hard to grind in. Most of the valves, such as gage cocks, water glass valves, and water glass drain valves, are built in two pieces and do not have a removable bonnet. When the packing nut is removed the bonnet comes with it, so that it's almost impossible to grind in the valve and seat. We have to dress off the valve with a file and dress the seat with a dummy valve. We pack piston rods and valve stems with rope asbestos, so you can guess what luck we have keeping down steam leaks. We have to fight like everything to keep them down.

"Recently we secured some small copper wire, about No. 10 size, and we are using it to make copper gaskets for the small steam joints. These engines have no fountain, and every pipe comes from the boiler direct with a flange joint, and an asbestos gasket, at the boiler. So we have troubles of our own. Most of the piping is copper, with brazed joints. Injector branch pipes are made this way. When we get a bad leak we can't go to the storehouse and get a Crane fit-



French Motive Power with an American Crew

rod operating the variable exhaust nozzle runs along the side of the boiler through brackets similar to hand-hole brackets, and is used as a handrail. One can easily see the throttle rod running from the cab through the auxiliary dome, sand dome, main dome and throttle box with stuffing boxes on the back of the main dome and front of the throttle box.

"The cab has no front door. One passes outside of the cab forward, using the handholds and steps shown along the sides of the cab in order to go forward over the water tanks."

The effect of inadequate facilities coupled with severe weather has evidently been felt in France as well as America during the past winter. In another letter Sergeant Foster writes:

"This letter is to all my friends, who were so generous in sending me a splendid big box of good old American tobacco. Words cannot express my thanks.

"I am working in an assortment of men from six different American roads. The men from these six companies work in two different towns. Just imagine working in a place like Cushing, Okla., with all the cold weather of Michigan and all the rains of Seattle, and very heavy business.

"Our coal chute consists of a string of cars, and the men have to throw the coal from the cars into the tenders. Some of the cabs do not give much protection from the rain, and

ting, but we hunt up the coppersmith, and usually kill the engine and then braze the pipe.

"Flues don't give us much trouble because we have no laws against flue plugs, and we have plenty of plugs. The copper fireboxes don't give much trouble either. Most of the firebox leaks take up when the engine gets out on the road. The front ends are not self-cleaning, so we have to watch them closely and keep the flues bored out daily.

"Our tools are very poor. We have monkey wrenches that you can work, provided you have a nut out in the prairie without anything around it. The hammers are heavy, and are splendid for an apprentice because they have faces as big as young sledges. The fireboxes are all narrow and most of them are very small. Most of them do not have any rocking and dump grates, so the fire cleaners have to shovel the old fire out of the firedoors. Believe me, it's lovely."

FREIGHT CARS TAKE WOUNDED TO GERMANY.—Trains carrying wounded Germans from the battle front in France are proceeding continuously between Germany and Holland, according to a despatch to the Telegraf from Kerkrade. It has been necessary to replace hospital cars by freight cars, in which the wounded lie on straw and shavings.

# STATUS OF STANDARD LOCOMOTIVES

## Probable Extent to Which They Will Be Used; Tentative General Dimensions of Proposed Types

WHILE the details of the designs of the standard locomotives for the United States government have not been completed, a tentative specification has been drawn up giving the general dimensions of the 12 locomotives proposed. These have been sent to the railway companies with a request for the number of each design each road will need to meet its requirements for new locomotives this year. The roads were cautioned to check the limiting dimensions carefully and to allow for axle loads slightly heavier than those shown, as an added precaution, for it

operate locomotives of the wheel loads of the standard locomotives would be filled with locomotives of lighter axle load, which would be released by the standard locomotives.

Since these specifications were sent out a number of conferences have been held at the headquarters of the Railroad Administration in Washington on the subject of standardization, at which the matter has been discussed by C. R. Gray, director of the division of transportation, Henry Walters, who has been in general charge of the proposed standardization program for the director general, S. M. Vauclain

GENERAL DIMENSIONS OF THE MIKADO, SANTA FE AND MALLET STANDARD LOCOMOTIVES FOR THE RAILROAD ADMINISTRATION

Type	Mikado	Mikado	2-10-2	2-10-2	2-6-6-2	2-8-8-2
Axle load	55,000 lb.	60,000 lb.	55,000 lb.	60,000 lb.	60,000 lb.	60,000 lb.
Specification Number	1-A	2-A	7	8	11	12
Gage	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.
Service	Freight	Freight	Freight	Freight	Freight	Freight
Fuel	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal	Bit. coal
Tractive effort	54,600 lb.	60,000 lb.	69,400 lb.	74,000 lb.	80,300 lb.	106,000 lb.
Weight in working order	290,000 lb.	325,000 lb.	360,000 lb.	390,000 lb.	440,000 lb.	540,000 lb.
Weight on drivers	220,000 lb.	240,000 lb.	275,000 lb.	300,000 lb.	360,000 lb.	480,000 lb.
Weight on leading truck	23,000 lb.	27,000 lb.	30,000 lb.	30,000 lb.	27,000 lb.	30,000 lb.
Weight on trailing truck	47,000 lb.	58,000 lb.	55,000 lb.	60,000 lb.	53,000 lb.	30,000 lb.
Weight of engine and tender in working order	466,000 lb.	497,000 lb.	532,000 lb.	596,000 lb.	646,000 lb.	746,000 lb.
Wheel base, driving	16 ft. 9 in.	16 ft. 9 in.	21 ft.	22 ft. 4 in.	31 ft. 2 in.	42 ft. 1 in.
Wheel base, rigid	36 ft. 1 in.	31 ft. 1 in.	40 ft. 4 in.	42 ft. 2 in.	10 ft. 4 in.	15 ft. 6 in.
Wheel base, total	71 ft. 5½ in.	71 ft. 9½ in.	76 ft. ½ in.	82 ft. 10½ in.	50 ft. 2 in.	57 ft. 4 in.
Wheel base, engine and tender					88 ft. 10 in.	93 ft. 3 in.
<b>Ratios</b>						
Weight on drivers ÷ tractive effort	4.0	4.0	4.0	4.1	4.5	4.5
Total weight ÷ tractive effort	5.3	5.4	5.2	5.3	5.5	5.1
Tractive effort × diam. drivers ÷ equivalent heating surface*	730.9	653.2	629.6	665.9	623.1	717.6
Equivalent heating surface* ÷ grate area	70.6	81.7	82.5	79.4	96.3	87.5
Firebox heating surface ÷ equivalent heating surface, per cent.	6.1	5.5	5.9	6.1	5.8	5.1
Weight on drivers ÷ equiv. heating surface*	46.8	41.5	43.8	42.9	49.0	57.0
Total weight ÷ equivalent heating surface*	61.6	56.2	57.3	56.2	59.9	64.1
Volume both cylinders	18.4 cu. ft.	21.2 cu. ft.	21.2 cu. ft.	26.4 cu. ft.	21.9 cu. ft.	26.9 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	255.3	272.9	296.3	265.2	336.1	312.7
Grate area ÷ vol. cylinders	3.6	3.3	3.6	3.3	3.5	3.6
<b>Cylinders</b>						
Kind	Simple	Simple	Simple	Simple	Compound	Compound
Diameter and stroke	26 in. by 30 in.	27 in. by 32 in.	27 in. by 32 in.	30 in. by 32 in.	23 in. & 35 in. by 32 in.	25 in. & 39 in. by 32 in.
<b>Valves</b>						
Kind	Piston	Piston	Piston	Piston	Piston	Piston
Diameter	14 in.	14 in.	14 in.	14 in.	14 in.	14 in.
<b>Wheels</b>						
Driving, diameter over tires	63 in.	63 in.	57 in.	63 in.	57 in.	57 in.
<b>Boiler</b>						
Style	Con. Wag. Top	Con. Wag. Top	Con. Wag. Top	Con. Wag. Top	Straight Top	Con. Wag. Top
Working pressure	200 lb. per sq. in.	190 lb.	200 lb.	190 lb.	225 lb.	240 lb.
Outside diameter of first ring	78 in.	86 in.	86 in.	88 in.	90 in.	98 in.
Firebox, length and width	114½ in. by 84½ in.	120½ in. by 84½ in.	114½ in. by 96½ in.	132½ in. by 96½ in.	114½ in. by 96½ in.	176½ in. by 96½ in.
Tubes, number and outside diameter	216—2½ in.	247—2½ in.	247—2½ in.	271—2½ in.	247—2½ in.	274—2½ in.
Flues, number and outside diameter	40—5½ in.	45—5½ in.	45—5½ in.	50—5½ in.	45—5½ in.	53—5½ in.
Tubes and flues, length	19 ft.	19 ft.	20 ft. 6 in.	20 ft. 6 in.	24 ft.	24 ft.
Heating surface, tubes	2,407 sq. ft.	2,752 sq. ft.	2,970 sq. ft.	3,258 sq. ft.	3,478 sq. ft.	3,960 sq. ft.
Heating surface, flues	1,090 sq. ft.	1,226 sq. ft.	1,323 sq. ft.	1,469 sq. ft.	1,549 sq. ft.	1,825 sq. ft.
Heating surface, firebox	286 sq. ft.	319 sq. ft.	373 sq. ft.	429 sq. ft.	429 sq. ft.	432 sq. ft.
Heating surface, total	3,783 sq. ft.	4,297 sq. ft.	4,666 sq. ft.	5,156 sq. ft.	5,456 sq. ft.	6,217 sq. ft.
Superheater heating surface	882 sq. ft.	993 sq. ft.	1,078 sq. ft.	1,230 sq. ft.	1,260 sq. ft.	1,475 sq. ft.
Equivalent heating surface*	4,706 sq. ft.	5,787 sq. ft.	6,283 sq. ft.	7,001 sq. ft.	1,346 sq. ft.	8,420 sq. ft.
Grate area	66.7 sq. ft.	70.8 sq. ft.	76.3 sq. ft.	88.2 sq. ft.	76.3 sq. ft.	96.2 sq. ft.
<b>Tender</b>						
Tank	Wat. Bot.	Wat. Bot.	Wat. Bot.	Wat. Bot.	Wat. Bot.	Wat. Bot.
Weight	172,000 lb.	172,000 lb.	172,000 lb.	206,000 lb.	206,000 lb.	206,000 lb.
Water capacity	10,000 gal.	10,000 gal.	10,000 gal.	12,000 gal.	20,000 gal.	12,000 gal.
Coal capacity	16 tons	16 tons	16 tons	16 tons	16 tons	16 tons

\*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

may be possible that after the locomotives are built the axle loads will be higher than those shown in the tentative specifications.

The circular accompanying the specifications included a statement to the effect that special designs for extreme grades or other operating features which require heavier locomotives than those included in the specifications were too few and extreme to require standardizing. It was also stated that requirements for locomotives for roads which could not

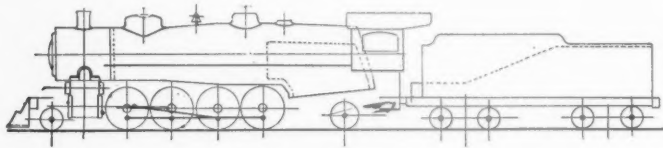
and the regional directors. As a result of these conferences the uncertainty as to the scope of the standardization plan has in a measure been cleared up by a memorandum which has been sent out to the managements of the various railroads, the text of which is as follows:

"It is appreciated that there are special conditions upon some railroads, in which there is an unusual or unique situation to be met.

"In these circumstances it is understood that any such

railroad is privileged to make representation to the director general as to its individual necessity for a departure from the standard type."

It is obvious that the effect which the principle enunciated in the foregoing will have upon the locomotive situation will depend on how broadly the principle stated is interpreted and applied. Strictly interpreted, it would mean

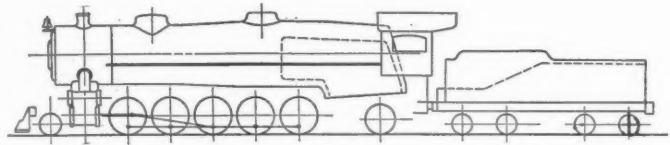


Outline of U. S. Standard Mikado Type Locomotive

that only a few railroads having very special conditions or unique situations would be furnished with any locomotives departing from the standard type. On the other hand, broadly interpreted, it might result in all railroads having

A general outline of the different types of locomotives proposed and a list of the general dimensions and data is given in the illustrations and tables.

There are three designs of tenders to be used with the 12



Outline of Standard 2-10-2 Type Locomotive

different locomotives, one having a capacity of 8,000 gal., another 10,000 gal., and the third 12,000 gal., all having a coal capacity of 16 tons. Unless some good and sufficient reason is given with the order for the different locomotives, the tenders shown with the specifications of the locomotives will be provided.

In the main it has been the desire of the committee de-

GENERAL DIMENSIONS OF THE PACIFIC, MOUNTAIN AND SWITCHER STANDARD LOCOMOTIVES FOR THE RAILROAD ADMINISTRATION

Type	Pacific	Pacific	Mountain	Mountain	0-6-0	0-8-0
Driving axle load	55,000 lb.	60,000 lb.	55,000 lb.	60,000 lb.	55,000 lb.	55,000 lb.
Specification Number	5-A	6-A	3-A	4-A	9	10
Gage	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.
Service	Passenger	Passenger	Passenger	Passenger	Switching	Switching
Fuel	Bit. Coal	Bit. Coal	Bit. Coal	Bit. Coal	Bit. Coal	Bit. Coal
Tractive effort	40,700 lb.	43,800 lb.	53,900 lb.	58,000 lb.	39,100 lb.	51,200 lb.
Weight in working order	270,000 lb.	300,000 lb.	320,000 lb.	350,000 lb.	165,000 lb.	220,000 lb.
Weight on drivers	165,000 lb.	180,000 lb.	220,000 lb.	240,000 lb.	165,000 lb.	220,000 lb.
Weight on leading truck	52,000 lb.	60,000 lb.	50,000 lb.	55,000 lb.	.....	.....
Weight on trailing truck	53,000 lb.	60,000 lb.	50,000 lb.	55,000 lb.	.....	.....
Weight of engine and tender in working order	414,000 lb.	444,000 lb.	492,000 lb.	522,000 lb.	309,000 lb.	364,000 lb.
Wheel base, driving	13 ft.	14 ft.	18 ft. 3 in.	18 ft. 3 in.	11 ft. 0 in.	15 ft. 0 in.
Wheel base, total	34 ft. 9 in.	36 ft. 2 in.	40 ft. 0 in.	40 ft. 0 in.	11 ft. 0 in.	15 ft. 0 in.
Wheel base, engine and tender	68 ft. 7½ in.	70 ft. 8½ in.	75 ft. 8½ in.	75 ft. 8½ in.	48 ft. 10½ in.	52 ft. 10½ in.
Ratios						
Weight on drivers ÷ tractive effort	4.1	4.1	4.1	4.1	4.2	4.3
Total weight ÷ tractive effort	6.6	6.8	5.9	6.0	4.2	4.3
Tractive effort × diam. drivers ÷ equivalent heating surface*	656.7	674.1	668.2	637.0	607.6	700
Equivalent heating surface* ÷ grate area	67.8	72.5	78.6	82.4	79.0	80.1
Firebox heating surface ÷ equivalent heating surface, per cent.	5.8	6.1	6.4	5.9	5.6	5.7
Weight on drivers ÷ equiv. heating surface*	36.5	35.1	39.5	38.2	63.3	58.9
Total weight ÷ equivalent heating surface*	59.7	58.5	57.5	55.7	63.3	58.9
Volume both cylinders	15.9 cu. ft.	18.6 cu. ft.	19.9 cu. ft.	21.4 cu. ft.	11.2 cu. ft.	15.9 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	284.4	276.6	280.0	293.9	232.3	244.5
Grate area ÷ vol. cylinders	4.2	3.8	3.6	3.6	2.9	2.9
Cylinders						
Kind	Simple	Simple	Simple	Simple	Simple	Simple
Diameter and stroke	25 in. by 28 in.	27 in. by 28 in.	27 in. by 30 in.	28 in. by 30 in.	21 in. by 28 in.	25 in. by 28 in.
Valves						
Kind	Piston	Piston	Piston	Piston	Piston	Piston
Diameter	14 in.	14 in.	14 in.	14 in.	10 in.	14 in.
Wheels						
Driving, diameter over tires	73 in.	79 in.	69 in.	69 in.	51 in.	51 in.
Boiler						
Style	Con. W. T.	Con. W. T.	Con. W. T.	Con. W. T.	Straight top	Straight top
Working pressure, lb. per sq. in.	200	200	200	200	190	175
Outside diameter of first ring	76 in.	78 in.	78 in.	86 in.	66 in.	80 in.
Firebox, length and width	114¼ in. by 84¼ in.	120¼ in. by 84¼ in.	120¼ in. by 84¼ in.	114¼ in. by 96¼ in.	72¼ in. by 66¼ in.	102¼ in. by 66¼ in.
Tubes, number and outside diameter	188—2¼ in.	216—2¼ in.	216—2¼ in.	247—2¼ in.	158—2 in.	230—2 in.
Flues, number and outside diameter	36—5½ in.	40—5½ in.	40—5½ in.	45—5½ in.	24—5½ in.	36—5½ in.
Tubes and flues, length	19 ft. 0 in.	19 ft. 0 in.	20 ft. 6 in.	20 ft. 6 in.	15 ft. 0 in.	15 ft. 0 in.
Heating surface, tubes	2,091 sq. ft.	2,407 sq. ft.	2,598 sq. ft.	2,970 sq. ft.	1,233 sq. ft.	1,796 sq. ft.
Heating surface, flues	981 sq. ft.	1,090 sq. ft.	1,176 sq. ft.	1,323 sq. ft.	515 sq. ft.	773 sq. ft.
Heating surface, firebox	234 sq. ft.	284 sq. ft.	329 sq. ft.	346 sq. ft.	130 sq. ft.	190 sq. ft.
Heating surface, arch tubes	27 sq. ft.	27 sq. ft.	27 sq. ft.	27 sq. ft.	16 sq. ft.	22 sq. ft.
Heating surface, total	3,333 sq. ft.	3,808 sq. ft.	4,130 sq. ft.	4,666 sq. ft.	1,894 sq. ft.	2,781 sq. ft.
Superheater heating surface	794 sq. ft.	882 sq. ft.	957 sq. ft.	1,078 sq. ft.	475 sq. ft.	637 sq. ft.
Equivalent heating surface	4,524 sq. ft.	5,133 sq. ft.	5,566 sq. ft.	6,283 sq. ft.	2,607 sq. ft.	3,737 sq. ft.
Grate area	66.7 in.	70.8 sq. ft.	70.8 sq. ft.	76.3 sq. ft.	33 sq. ft.	46.6 sq. ft.
Tender						
Tank	Water Bot.	Water Bot.	Water Bot.	Water Bot.	Water Bot.	Water Bot.
Weight	144,000 lb.	144,000 lb.	172,000 lb.	172,000 lb.	144,000 lb.	144,000 lb.
Water capacity	8,000 gal.	8,000 gal.	10,000 gal.	10,000 gal.	8,000 gal.	8,000 gal.
Coal capacity	16 tons	16 tons	16 tons	16 tons	16 tons	16 tons

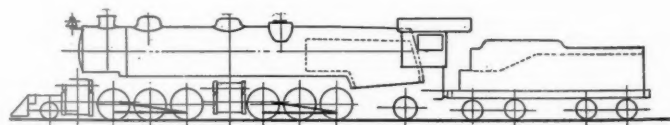
\*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

special conditions being allowed to get locomotives adapted to those special conditions. Now, as there is hardly a railway management which has not believed in the past that it had had "special conditions" on at least part of its lines, the broad interpretation of the principle would result in the ordering of many locomotives besides the standard locomotives.

signing the locomotives to provide designs which will best meet average conditions. For instance, freight locomotives of the Mikado, Santa Fe and Mallet types have been evolved which have the following tractive efforts: 54,600 lb., 60,000 lb., 69,400 lb., 74,000 lb., 80,300 lb. and 106,000 lb. This covers the range of tractive efforts for freight service fairly well. The boiler factors of the heavy Mikado and of both

of the Santa Fe type locomotives are sufficiently high to permit increased tractive effort by increasing the boiler pressure. The Pacific and Mountain type locomotives for passenger service have tractive efforts of 40,700 lb., 43,800 lb., 53,900 lb. and 58,000 lb. The six-wheel and eight-wheel switchers have tractive efforts of 39,100 lb. and 51,200 lb. respectively.

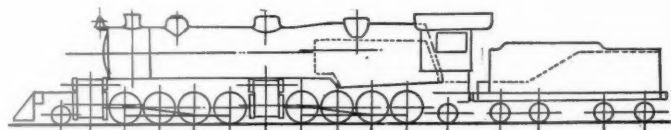
There are two sizes of drivers used on the freight engines: 63 in. in diameter for both Mikados and the heavy Santa Fe



Outline of Standard 2-6-6-2 Mallet

type and 57 in. in diameter for the light Santa Fe and both the Mallet types. The light Pacific type locomotive has a 73-in. wheel, the heavy Pacific a 79-in. wheel and both the Mountain types a 69-in. wheel. The wheels of both switchers are 51 in. in diameter. Superheaters and brick arches are used on all of the locomotives, and it has been said that the Santa Fe and Mallet types will be equipped with stokers. All designs except the switchers are provided with combustion chambers. It may be said that with a possible exception of the two Pacific type locomotives, the boilers are of ample capacity.

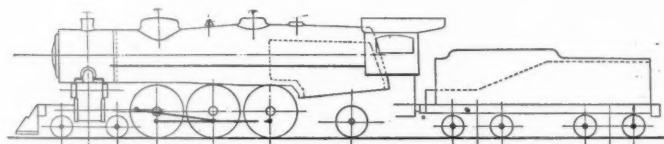
The locomotives are all designed to traverse 19-deg. curves



Outline of Standard 2-8-8-2 Mallet

and grades of two per cent. The clearance limitations are practically alike, the over-all height being 15 ft., with the exception of the heavy Santa Fe type and the 2-8-8-2 Mallet, which have height clearance of 15 ft. 9 in. The width over cylinders is 10 feet. 4 in. for all designs, with the exception of the heavy Santa Fe type and the large Mallet, which is 10 ft. 9 in. and the smaller Mallet, which is 10 ft. 6 in. The width over cab body and over cab eaves, including the cab handles, is the same for all designs, being 10 ft. in the first case and 10 ft. 2 in. in the second.

A casual study of these limitations indicates that there will be some difficulties, particularly around terminals, due



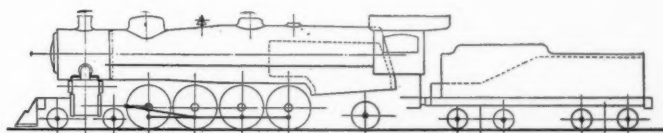
Outline of Standard Pacific Type

to low bridges. The Boston & Maine has three bridges around Boston with a clearance of 14 ft. 9 in. There are the same limitations on some bridges in the vicinity of the Union Station in Cincinnati; between the Chicago Terminal and the California yards of the North Western there is a limitation of 14 ft. 10 in. and on the C. B. & Q. between St. Louis and East St. Louis the limitations are 14 ft. 7 in. On the Michigan Central at Detroit the minimum clearance is 14 ft. 3 in. On the main line of the Chesapeake & Ohio, between Charlottesville and Clifton Forge, Va., a distance of 116 miles, the minimum clearance is 15 ft. This is in a mountainous territory and it will be impossible to use either

the heavy Santa Fe type or the 2-8-8-2 Mallet. The 2-6-6-2 Mallet will, however, come within these limitations. The Hoosic tunnel of the Boston & Maine has a height clearance of 14 ft. 8 in., which will prevent any of these standard locomotives passing through this tunnel.

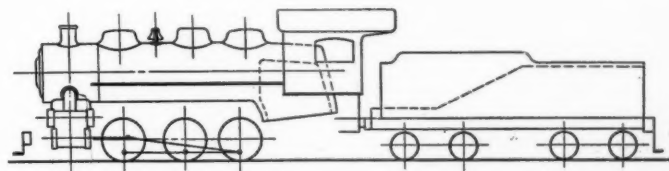
Present indications are that about 1,000 of the standard locomotives will be bought at first and that they will be intended primarily to serve as a flying squadron which can be used on the lines which have not enough locomotives to handle all the traffic which must be moved over them.

It is estimated that there are now about 600 engines



Outline of Standard Mountain Type

in service on foreign lines. As the standard locomotives are delivered it is probable that they will replace these foreign engines and that the foreign engines will be returned to the home lines. While the foreign engines have been taken from numerous railways, they are being used on a comparatively small number of lines. Therefore, if the standard locomotives are used mainly to replace them, the result will be that in the early stages, at least, they will be used on only a comparatively small number of roads. As a matter of fact, the Railroad Administration does not know where it will send the standard locomotives at first, but it is considered by some officers of the administration that

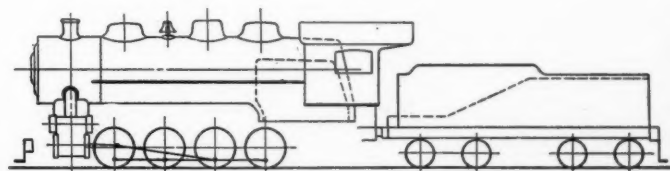


Outline of Standard Six-Wheel Switcher

it will be logical to send home as rapidly as possible the engines that are now off the lines of the owning roads and to replace them with the standard locomotives as rapidly as they are built.

The interchange of power is questionable practice at any time. Under existing conditions, however, it has been found necessary. If standard locomotives are considered at all they should be considered for only such service and only that number which is necessary for a liquid reserve should be built.

Probably whether additional locomotives of the same types



Outline of Standard Eight-Wheel Switcher

or of other standard types will be ordered will depend to a considerable extent on the results secured with these locomotives. The Railroad Administration intends to appoint a special committee to study the results of the operation of the standard locomotives. One thing seems certain and this is that the principle of standardization of locomotives has not

been finally established even for the period of government control and the future developments and discussion have yet to determine whether it will finally become firmly established.

### 100 PER CENT GOAL IN RAILROAD LIBERTY LOAN CAMPAIGN

"I hope that every railroad employee in the United States will lend all the money he can, consistently with his individual circumstances, to his government in buying Liberty Bonds," says Director General McAdoo in Circular No. 24 on the Railroad Wage Commission.

"In lending your money to the government you not only save the money for yourselves, but you help every gallant American soldier and sailor who is fighting in this war now to save your lives and liberties and to make the world safe for democracy."

With an organization that reaches every employee in railway service, from the presidents down, the railway men of this country are enthusiastically working to take a large share of the total issue of the Third Liberty Loan, and are doing their utmost to live up to their brothers who are making a record for themselves in the railway engineer regiments in France.

The Eastern Committee, of which President Underwood of the Erie is chairman, reports that the Liberty Loan campaign is making fine progress on the railways of the eastern regional district. Details as to the number of subscribers and the amounts taken, however, have only been received from a few roads. Up to Wednesday, April 24, subscrip-

third loan would be *more than double those for the second loan.*

About 15,000 individual subscriptions totaling about \$1,400,000 had been received from employees on the railroad east of Buffalo, and about 10,000 subscribers had taken \$1,120,000 on the line west of Buffalo, up to this date, making the total for employees of both major portions of the company line \$2,520,000 recorded thus far. In the second loan, 20,894 employees of the New York Central Railroad proper subscribed for \$1,343,050.

The Lackawanna is one of the roads which is already beginning to talk about 100 per cent subscriptions. Up to Wednesday, April 24, only the road was able to report the following percentages of subscribers among the employees:

	Per cent
*Station employees .....	95.8
Conductors .....	88.9
Trainmen .....	67.4
Switchmen .....	81.1
Yardmasters and clerks .....	81.4
Superintendents' offices .....	97.5
Shopmen, carmen, roudhousemen, etc. ....	73.9
Locomotive engineers .....	65.9
Locomotive firemen .....	44.2

\*The above figures do not include the freight house laborers.

Returns from western railroads received up till noon of April 24 show total subscriptions to the Third Liberty Loan of \$37,353,000, or an increase of \$1,759,000 in the last 24 hours; 465,000 out of 751,000 employees of the western roads have so far subscribed to the loan. The Rock Island system led with subscriptions for 98.55 per cent of its employees.

Then western railroads had reported up to Monday, April 22, subscriptions exceeding \$1,000,000. They were:

Road	Per cent of employees	Subscriptions	Average
Chicago, Rock Island & Pacific.....	96.22	\$2,689,150	69.21
Chicago, Milwaukee & St. Paul....	74.30	2,461,150	69.84
Northern Pacific .....	83.58	2,398,450	90.00
Chicago & North Western.....	60.19	2,337,200	71.90
Atchison, Topeka & Santa Fe.....	49.43	2,327,350	73.60
Great Northern .....	58.83	1,987,050	99.35
Missouri Pacific .....	71.25	1,961,450	70.97
Chicago, Burlington & Quincy....	50.44	1,714,450	73.51
Union Pacific .....	55.21	1,172,800	73.88
Southern Pacific .....	33.21	1,109,850	71.90

#### COMMITTEES OF OFFICERS AND EMPLOYEES

The Liberty Loan campaign on the railroads has been so well organized that every railway man has been reached by the members of a committee in his department or branch of service.

The organization at the top includes three committees of railroad presidents, one committee each for the three regional districts.

The eastern regional district committee is headed by F. D. Underwood, president of the Erie, and includes the following members: W. H. Truesdale, president of the Delaware, Lackawanna & Western; Frank Trumbull, chairman of the board of the Chesapeake & Ohio; E. E. Loomis, president of the Lehigh Valley; L. F. Loree, president of the Delaware & Hudson; Howard Elliott, chairman of the committee on intercorporate relations of the New York, New Haven & Hartford, and John B. Dennis of Blair & Co.

The western committee is headed by W. S. Bierd, president of the Chicago & Alton, and its members include J. E. Gorman, president of the Chicago, Rock Island & Pacific; H. E. Byram, president of the Chicago, Milwaukee & St. Paul; H. G. Hetzler, president of the Chicago & Western Indiana; C. H. Markham, president of the Illinois Central; A. M. Schoyer, resident vice-president of the Pennsylvania Lines; C. G. Burnham, executive vice-president of the Chicago, Burlington & Quincy.

E. T. Lamb, president of the Atlanta, Birmingham & Atlantic, is chairman of the Liberty Loan committee which has been appointed for the southern regional district. The other members of the committee are H. W. Miller, vice-president of the Southern; C. A. Wickersham, general man-



New York Central Honor Flag.

Awarded to each department showing 75 per cent of personnel subscribed. A star is placed in the field beneath the eagle's wings for each additional 5 per cent. Some departments have reported "100 per cent subscribed" and claimed the honor flag with 5 stars. The flag has border and frame of deep red, with lettering and decorations in blue and white, the background being buff. It is 30 by 20 in.

tions were reported from 94,737 employees for a total of \$6,060,260.

Judging by the reports from two of the eastern roads, the totals should show a great increase over the figures for the second loan and the percentage of employees subscribing should reach well into the nineties.

The secretary of the general committee in charge of the canvass of employees of the New York Central Lines for sale of the Third Liberty Loan bonds, which is engaging the organized work of over 3,500 employees on committees and teams on the system, stated that returns already received at general headquarters in Grand Central Terminal, New York, and tabulated up to Friday, April 26, assured that the subscriptions by New York Central Railroad employees (other lines of the system not included) for the

ager of the Georgia Railroad; and W. L. Stanley, assistant to the president of the Seaboard Air Line.

The president of every railroad in the country has been called upon to direct the work on his railroad. To make sure that no employee will lack a chance to know about the loan or to subscribe to the extent of his ability committees have been formed of employees in every office, shop and terminal.

On the New York Central, to take one example, there are 650 divisional and departmental committees, each with specific responsibility, territory and lists, these embracing as active workers more than 3,500 employees.

A specially-designed "Honor Flag" is awarded to each department showing 75 per cent of its personnel as subscribers to bonds, a star being added for each additional 5 per cent. Already numerous departments have reported "100 per cent subscribed" and claimed the flag with five stars.

Girl employees with brothers or family members at the front form a unique branch of the New York Central organization selling Liberty bonds. They are the special "storm troops" or "shock squads," as it were, of the army of 3,500 bond canvassers, being used to win over those "hard cases" when other appeals have failed. When an employee who is well able to invest resists all efforts and is reported by the regular "team" as hopelessly indifferent or laggard, a "squad" of the girls makes the final effort. Every one of the girls has a brother, husband or father in the fighting forces, this being a necessary qualification, and with thoughts of the needs of their loved ones "over there" which the bond money would supply as an inspiration, their pleas seldom fail to convert reluctant investors.

#### "SAFETY FIRST" YIELDS TO "LIBERTY FIRST"

For the final week of the bond-selling on the New York Central, the "Safety First" organization has changed its slogan to "Liberty First." The regular "safety meetings" held by employees under direction of local committees have been devoted to arousing enthusiasm for the third bond issue.

Marcus A. Dow, general safety agent of the system, as this is written is holding a series of Liberty bond mass-meetings for railroad employees, on a fast tour that will cover all the big centers to Buffalo. Commencing at the Harmon shops, the schedule includes big rallies for employees at West Albany, Rensselaer, Utica, Frankfort, Syracuse, Depew, Rochester, Buffalo and Niagara Falls.

Two veterans of the war, invalidated for wounds, accompanied Mr. Dow and addressed the railroad employees' gatherings, telling of conditions and their personal experiences in the trenches. These were Private L. C. Burgess, a bomber who saw three years' service with the famous Canadian "Princess Pats" and lost an eye for liberty, and Private H. J. Pickell, who served three years with the 24th Battalion, Canadian Infantry, and was wounded at Vimy Ridge.

The meetings in shops, roundhouses, at stations and in switching yards have been marked by the greatest enthusiasm, the railroad men being particularly interested in hearing about the American railway engineers who threw down their shovels and seized rifles at Cambrai, thereby becoming the first of our expeditionary forces in battle.

One of the features of the campaign on the Erie is a Liberty Loan train. This train was run from Hammond, Ind., to Jersey City and stopped at the division points and shops on the route. With the train was the Erie's general office band. General Manager R. S. Parsons accompanied the train and he and the local speakers addressed the Erie employees at the important centers along the route.

C. H. Markham, regional director of the Southern railroads, has sent out two special war relic trains, which left

Atlanta April 6, on a tour to last 27 days. One train covered central and eastern Tennessee, all of Georgia and a large part of Florida. The second train covered portions of central Tennessee, all of Alabama, southern Mississippi and southern Louisiana. Each train carried ten American artillery officers accompanied by French and Canadian soldiers and officers and Liberty Loan speakers.

Apparently the work of some of the committees has been as insistent as it has been enthusiastic. The Altoona Tribune, for example, had the following interesting story in a recent issue:

"Twenty-six men in one Altoona machine shop department yesterday placed a strenuous objection with officials when three of their mates failed to acquire war bonds of the present issue. An ultimatum was issued and if the trio continues to ignore the solicitors after 7 a. m. today they must quit or the twenty-six loyalists will.

"Several clerks in one of the offices at the same shops yesterday made it known they weren't going to wear the red-white-and-blue button designating the subscribers to the third loan. A petition was hastily drawn up and all other workers in the office signed it, stating they would resign if the status of the affair wasn't changed favorably."

### CENSUS STATISTICS OF RAILROAD REPAIR SHOPS

In 1914 there were 1,362 steam railroad repair shops, which shops hired on the average 361,925 persons. The value of the products of these shops was \$514,041,225. For the same year there were 103 establishments engaged in the manufacture of freight and passenger cars for steam railroad service. These establishments, on the average, hired

Table 29

VALUE OF PRODUCT.	Census year.	Number of establishments.	Average number of wage earners.	Value of products.	Value added by manufacture.
All classes.....	1914 1909	1,362 1,145	339,518 282,174	\$514,041,225 405,600,727	\$270,212,618 206,187,315
Less than \$5,000.....	1914 1909	44 52	115 152	133,531 163,034	81,776 98,548
\$5,000 to \$20,000.....	1914 1909	154 149	1,584 1,515	1,865,296 1,760,898	1,202,354 1,124,545
\$20,000 to \$100,000.....	1914 1909	358 286	14,430 12,059	19,548,203 14,701,863	12,158,925 8,963,187
\$100,000 to \$1,000,000.....	1914 1909	684 564	168,586 152,534	237,177,633 199,863,116	133,985,665 109,493,358
\$1,000,000 and over.....	1914 1909	122 94	154,803 115,914	255,810,562 189,111,816	122,783,898 86,507,677
Percent distribution:					
Less than \$5,000.....	1914 1909	3.2 4.5	(1) 0.1	(1) (1)	(1) (1)
\$5,000 to \$20,000.....	1914 1909	11.3 13.0	0.5 0.5	0.4 0.4	0.4 0.5
\$20,000 to \$100,000.....	1914 1909	26.3 25.0	4.3 4.3	3.8 3.6	4.5 4.3
\$100,000 to \$1,000,000....	1914 1909	50.2 49.3	49.7 54.1	46.1 49.3	49.6 53.1
\$1,000,000 and over.....	1914 1909	9.0 8.2	45.6 41.1	49.7 46.6	45.4 42.0

<sup>1</sup> Less than one-tenth of 1 per cent.

#### The Railroad Repair Shops Divided by Value of Products

58,988 persons and turned out a product the total value of which was \$194,775,699.

These figures were taken from a report of the Bureau of the Census entitled Steam and Electric Cars and Railroad Repair Shops, made public early in March, which presents statistics for establishments building cars for use on steam railroads; those building cars for use on electric railroads;

the operations of repair shops by steam railroad companies, and the operations of repair shops by electric railroad companies. An abstract of that portion of the report dealing with railroad repair shops follows. The original numbers of the tables have been retained.

*Scope of the combined industry.*—This industry is divided for census purposes into two classes—cars and general shop construction and repairs by steam-railroad companies, and cars and general shop construction and repairs by electric-railroad companies.

Every steam or electric railroad company of any magni-

the important industries covered by the statistics of manufactures.

*Size of establishments.*—The tendency of the industry to become concentrated in large establishments is indicated by the statistics given in Tables 29 and 30.

*Fuel.*—Coal is the principal class of fuel used in steam-railroad repair shops. In 1914, 506,696 tons of anthracite and 5,486,405 tons of bituminous coal were consumed in this industry. The other fuels used were coke, 79,597 tons; oil, 2,508,703 barrels; and gas, 1,829,902,000 cubic feet.

#### SPECIAL STATISTICS OF REPAIR SHOPS

Table 32 gives in detail the statistics of steam-railroad repair shops for 1914, 1909, 1904 and 1899.

The table shows fewer locomotives and cars built in steam-railroad repair shops in 1914 than during some of the earlier census years. The number of locomotives decreased by 85, or 31.2 per cent, from 1899 to 1914, and the number of cars built, by 16,188, or 60.1 per cent, but the total value of work done in these shops shows an increase of 135.5 per cent for the 15 years.

In 1914 the motive power and machinery department reported 46.1 per cent of the total value of products; car department, 47.3 per cent; bridge and building department, six-tenths of 1 per cent; and all other, or unclassified products, 6.1 per cent.

*EFFICIENCY AND FATIGUE IN BRITISH MUNITIONS FACTORIES.*—An interim report on "Industrial Efficiency and Fatigue," issued during the summer by the Health of Munition Workers Committee of the British Ministry of Munitions, has been reproduced in bulletin 230 of the Bureau of Labor Statistics of the U. S. Department of Labor. According to this report, night-work on the whole is regarded as undesirable, although there is no significant difference between the rate of output in night and day shifts managed on the discontinuous system which is preferred to

WAGE EARNERS PER ESTABLISHMENT.	NUMBER OF ESTABLISHMENTS.				AVERAGE NUMBER OF WAGE EARNERS.			
	1914	1909	Per cent of total.		1914	1909	Per cent of total.	
			1914	1909			1914	1909
All establishments....	1,362	1,145	100.0	100.0	339,518	282,174	100.0	100.0
1 to 5 wage earners.....	76	87	5.6	7.6	234	281	0.1	0.1
6 to 20 wage earners.....	194	164	14.2	14.3	2,503	2,128	0.7	0.8
21 to 50 wage earners.....	202	148	14.8	12.9	6,840	4,993	2.0	1.8
51 to 100 wage earners.....	213	162	15.6	14.1	15,634	11,848	4.6	4.2
101 to 250 wage earners.....	287	238	21.1	20.8	45,788	37,247	13.5	13.2
251 to 500 wage earners.....	197	180	14.5	15.7	67,492	63,821	19.9	22.6
501 to 1,000 wage earners.....	131	122	9.6	10.7	91,041	84,619	26.8	30.0
Over 1,000 wage earners.....	62	44	4.6	3.8	109,936	77,237	32.4	27.4

Railroad Repair Shops Divided by Number of Employees

tude operates one or more repair shops, chiefly for the purpose of maintaining the efficiency of the rolling stock. Such shops often manufacture complete cars and some of them manufacture complete locomotives. While the bulk of the work of the repair shops is on the rolling stock, they also do shopwork in connection with the construction and repair of bridges, buildings, etc. Most of the work done is on rolling stock operated by the company, but some compa-

CLASS OF WORK.	1914	1909	1904	1899 <sup>1</sup>	CLASS OF WORK.	1914	1909	1904	1899 <sup>1</sup>
Total value.....	\$514,041,225	\$405,600,727	\$309,775,089	\$218,238,277	Car department, value—Contd.				
Motive power and machinery department, value.....	\$236,723,724	\$184,971,870	\$149,643,953	\$94,447,260	Cars built, value—Continued.				
Locomotives built—					Other—				
Number.....	187	215	148	272	Number.....	308	359	2,000	( <sup>2</sup> )
Value.....	\$3,594,003	\$3,289,140	\$1,853,939	\$3,276,393	Value.....	\$253,005	\$267,153	\$645,392	( <sup>2</sup> )
Repairs to locomotives, motors, etc.....	\$169,057,932	\$127,028,773	\$101,326,805	\$57,383,143	Repairs to cars of all kinds.....	\$183,753,538	\$147,194,065	\$105,319,032	\$74,665,500
Work for other corporations.....	\$7,053,430	\$4,735,004	\$5,681,307	\$3,338,589	Work for other corporations.....	\$14,819,984	\$8,784,239	\$6,946,990	\$7,084,857
All other products or work.....	\$57,018,359	\$49,018,953	\$40,781,902	\$30,449,135	All other products or work.....	\$32,403,269	\$30,464,464	\$24,492,787	\$20,104,843
Car department, value.....	\$242,976,774	\$199,768,939	\$149,748,820	\$118,376,552	Bridge and building department (shopwork), value.....	\$3,127,644	\$2,799,898	\$5,096,141	\$5,414,465
Cars built, value.....	\$11,999,983	\$13,326,171	\$12,900,011	\$16,521,352	Repairs and renewals.....	\$2,449,821	\$1,906,737	\$4,351,487	\$3,937,170
Passenger—					Work for other corporations.....	\$37,061	\$46,496	\$40,581	\$241,626
Number.....	123	218	414	390	All other products or work.....	\$640,762	\$846,665	\$704,073	\$1,235,669
Value.....	\$1,233,302	\$1,291,354	\$2,337,977	\$1,441,733	All other products and work not classified, value.....	\$31,213,083	\$18,060,020	\$5,286,175	( <sup>2</sup> )
Freight—									
Number.....	10,314	13,972	14,742	26,543					
Value.....	\$10,513,676	\$11,767,664	\$10,006,642	\$15,079,619					

<sup>1</sup> Includes \$124,619 reported for Alaska.

<sup>2</sup> Not reported.

Statistics of Railroad Repair Shops, 1899, 1904, 1909 and 1914

nies do work of this character for others. The products are not ordinarily given a selling or contract value. The amount reported as the value for 1914 usually represented the cost of materials, salaries, wages, rent, and taxes. At prior censuses a miscellaneous expense item was reported, which to that extent increased the value of products. For steam-railroad repair shops this item amounted to \$3,946,043 in 1904 and \$5,886,066 in 1909, and for electric-railroad repair shops \$285,483 in 1904 and \$702,536 in 1909. The steam-railroad repair shops are far more important than the electric-railroad repair shops. In fact, measured by the number of persons employed, they constitute one of

continuous night-work, the latter being productive of definitely less output. The report shows that health and efficiency of workers are influenced by the earnings. In one factory 17 girls drilling fuses and working on the piece-rate basis, in one week increased their output by 24 per cent on the day-shift and by 40 per cent on the night-shift over their output when working on a time-wage basis. Among the men sleepiness on the night-shift, headache, footache, and muscular pains, together with nervous symptoms, are probably the most common signs of overwork. Eighty per cent of the lost time among the 1,543 men was due to sickness and 20 per cent to accident.

# THE DYNAMIC AUGMENT PROBLEM\*

The Need for Reducing the Weight of Reciprocating Parts; How the Reduction May Be Effected

BY E. W. STRONG

American Vanadium Company, Pittsburgh, Pa.

IN one respect there has been, generally speaking, no progress in locomotive design during the last decade; to the contrary, approved practice is not on a par with that of 10 years ago. This is in regard to the weights of the reciprocating and revolving parts per unit of load. H. A. F. Campbell in his series of articles on "Reciprocating and Revolving Parts," which began in the *Railway Age Gazette, Mechanical Edition*, March, 1915, presents data which discloses this fact very forcefully. And this condition exists

In this case, only 35 per cent of the reciprocating weight was balanced. The main counterweight lacks 691 lb. of balancing the revolving weights on the main pin. The average excess balance in the other wheels was 408 lb. Fig. 1 represents graphically the maximum dynamic augment in the main and other wheels of the same engine at various speeds from 15 miles per hour up to diameter speed. At 40 miles per hour, which is probably the maximum speed which this engine would ever attain, the dynamic augment in the main and other wheels is respectively 14,200 lb. and 8,400 lb., or 42½ per cent and 25 per cent, respectively, of the static weight of the wheel on the rail. Further, when the pressure of the main wheel on the rail is at its maximum the pressure of the other wheels is at a minimum. The charts

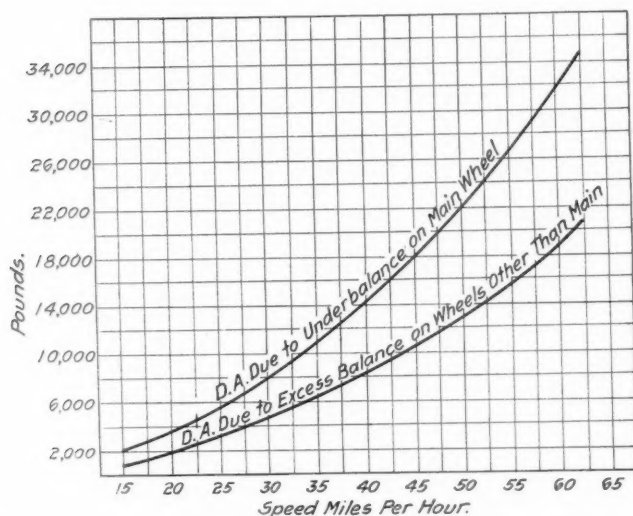


Fig. 1—Dynamic Augment in Wheels of a 2-10-2 Type Locomotive at Various Speeds

in face of the fact that never before has there been greater opportunity for betterment by taking full advantage of the developments in locomotive materials.

While it is perfectly true that with the enormous increase in wheel loads the ratio between the dynamic augment at diameter speed † and the static weight per wheel is even greater today in high speed engines than it was 25 years ago, it is equally true that present tremendous static wheel loads more nearly approach the capacity of the track. There is less margin of track capacity and less opportunity for increasing it. Furthermore, it is no longer the high speed engine which requires the most serious consideration, but the freight engine. And in the latter class it is not the dynamic augment due to the weight required to balance the reciprocating parts, but that due to lack of weight in the main counterweight to balance the revolving weight on the main crank pin.

This is particularly true of the 2-10-2 type locomotive. In most existing engines of this type the lack of balance for revolving weight in the main wheel causes a much greater dynamic augment than the excess balance in the other wheels for the reciprocating parts. The dynamic augment in the main wheel is, of course, directly opposite to that in the other wheels.

As an example, an engine having the proportions shown in Table I has been selected.

Boiler pressure .....	200 lb.
Cylinders .....	31 in. by 32 in.
Drivers, diameter .....	63 in.
Total weight in working order.....	401,000 lb.
Weight on drivers.....	335,000 lb.
Weight of reciprocating parts per side.....	2,604 lb.
Ratio of weight of reciprocating parts to total weight of engine .....	1/152
Piston thrust per pound of reciprocating weight.....	57.9 lb.
Revolving weight on main wheel.....	1,912 lb.

and the above figures refer to the dynamic augments in single wheels only and not to the combined augments of the counterbalances in the corresponding pairs.

The above example is not extreme. The engine selected is a very appropriate example, because it was built largely to the railroad's designs. It is the mechanical departments of the roads that must be impressed with the necessity of improvement in existing counterbalance conditions.

Fig. 2 is a chart similar to Fig. 1, representing the dynamic augment in a representative 4-6-2 type locomotive with 60 per cent of the weight of the reciprocating parts

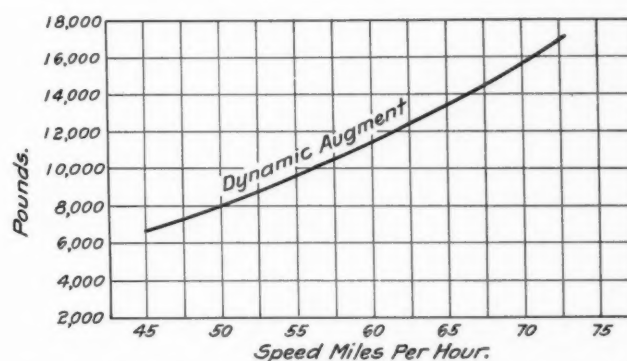


Fig. 2—Maximum Dynamic Augment in Wheels of a Pacific Type Locomotive

balanced. In this case, of course, there was no difficulty in fully balancing the revolving weights on the main pin. This engine has the proportions shown in Table II.

The factor which made possible the development of the Pennsylvania Class E6 engines was the use of especially light reciprocating parts. With 66,500 lb. on a single pair of drivers, these engines established a record. By so reducing the weight of the reciprocating parts as to keep the dynamic augment within 30 per cent of the static weight on

\*From a paper read before the February, 1918, meeting of the New York Railroad Club.

†Speed in miles per hour equal to the diameter of the drivers in inches.

a wheel point, it was possible safely to use this enormous axle load. In fact, these engines produce less strain on track and bridges than many having 10,000 lb. to 12,000 lb. less weight on drivers.

The locomotive impact tests made by the Chicago, Burlington & Quincy point very clearly to the possibilities of using heavier and more powerful units on track that is at present

TABLE II.—PROPORTIONS OF PROPERLY BALANCED ENGINE	
Boiler pressure .....	200 lb.
Cylinders .....	27 in. by 28 in.
Drivers, diameter .....	73 in.
Total weight in working order.....	305,500 lb.
Weight on drivers.....	197,300 lb.
Weight of reciprocating parts, per side.....	1,880 lb.
Ratio of weight of reciprocating parts to total weight of engine .....	1/162
Piston thrust per pound of reciprocating weight.....	64 lb.

loaded to capacity, through simply lightening the reciprocating and revolving parts, with consequent reduction in the dynamic augment. Four locomotives were tested, two of the 2-10-2 type and two of the Pacific type. Of each pair, one engine had especially light reciprocating parts made of heat-treated alloy steel and the other parts made of ordinary steel. The two 2-10-2 type engines had approximately the same weight on drivers, while the reciprocating parts in one weighed 16 per cent less than in the other. With the Pacific type locomotives, the one with light reciprocating parts was 16,600 lb. heavier on drivers and had 6,600 lb. greater tractive effort, while the weight of the reciprocating parts was 5 per cent less than in the other.

The results showed that in the case of the 2-10-2 type engines, the maximum impact on the rail of the one with light reciprocating parts was 35 per cent less than that of the other. In both cases the speed was about 40 miles per hour. In the case of the Pacifics, the one with the light reciprocating parts, though 10 per cent heavier on drivers than the other, produced less stress on track and bridges.

By taking advantage of the greater strength of alloy and special steel forgings and castings to use increased unit stresses, by using hollow bored crank pins and piston rods, rolled steel or alloy and special cast steel pistons, and by

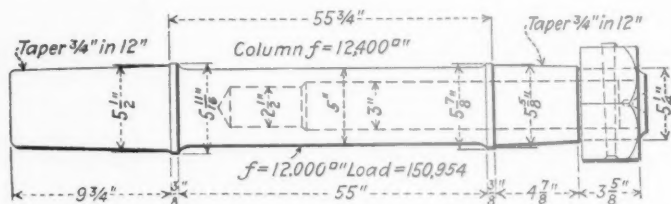


Fig. 3—Design of Piston Rod of Annealed Carbon-Vanadium Steel for 2-10-2 Type Locomotive

special care in the design of all details, a large percentage of saving can be effected in the weights of reciprocating parts.

By far the great majority of roads using alloy steel forgings have been content to utilize them to provide an increased

TABLE III.—WEIGHT OF RECIPROCATING PARTS OF THREE CLASSES OF PENNSYLVANIA LOCOMOTIVES.			
	4-4-2	4-6-2	2-8-2
Total weight .....	240,000 lb.	305,000 lb.	315,000 lb.
Weight on drivers .....	133,100 lb.	200,000 lb.	238,000 lb.
Cylinders .....	23 1/2 by 26 in.	27 in. by 28 in.	27 in. by 30 in.
Diameter of drivers .....	80 in.	80 in.	62 in.
Piston thrust .....	89,000 lb.	114,000 lb.	114,000 lb.
Weight of reciprocating parts per side .....	1,014 lb.	1,376 lb.	1,470 lb.
Piston thrust per pound reciprocating weight .....	87 lb.	83 lb.	77 lb.

factor of safety. The few cases in which advantage has been taken of high tensile steels to reduce weights of reciprocating parts serve to show the possibilities. The Pennsylvania Railroad was the first to use especially light reciprocating parts;

and still furnishes the most conspicuous example of such practice.

The weights of the reciprocating parts and the general proportions of three of their standard classes of road engines are given in Table III. For main and side rods, piston rods, pins and valve motion parts they use carbon steel, heat-treated to give a minimum elastic limit of 50,000 lb., and 80,000 lb. tensile strength. Rolled steel pistons are employed; while the crossheads are made of .40 carbon electric furnace cast steel, having a tensile strength of 70,000 to 80,000 lb. per sq. in. By using sections which take full advantage of the greater strength of the materials employed, combined with the greatest care and attention to detail de-

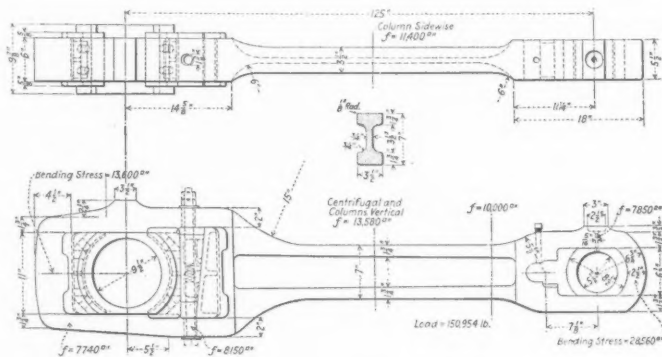


Fig. 4—Main Rod for 2-10-2 Type Locomotive Made of Annealed Carbon-Vanadium Steel

sign, exceptionally light reciprocating parts have been attained.

The Pacific and 2-10-2 type locomotives on the C. B. & Q. previously referred to, are other well known examples of the application of especially light reciprocating parts. On these engines, heat-treated Nichrome steel was used for the piston rods, connecting rods, stub straps, pins and eccentric cranks. Pistons and crossheads were made of .40 carbon cast steel. In the 2-10-2 type engines, the weight of the reciprocating parts was reduced 16 per cent. In addition, the weight of the revolving parts on the main pin were so reduced as to make it possible to omit counterweight bobs on the main axle. In previous sister engines with ordinary carbon steel parts, it had been necessary to follow such practice. A total saving in weight of 1,023 lb. per side was effected. The increase in the various calculated maximum stresses in the main and side rods as compared with the builders' standard practice for plain carbon steel averaged 21 per cent.

One of the most recent instances of utilizing higher tensile steels to lighten reciprocating parts is furnished by the powerful Pacifics built for the El Paso & Southwestern. For this purpose, heat-treated chrome-vanadium steel was specified for the main and side rods, piston rods, crank pins, eccentric cranks and crossheads. The engines had the following general proportions:

Boiler pressure .....	200 lb.
Total weight in working order.....	311,500 lb.
Weight on drivers.....	190,000 lb.
Cylinders .....	27 in. by 28 in.
Diameter of drivers.....	73 in.
Piston thrust .....	114,500 lb.
Weight of reciprocating parts.....	1,628 lb.
Piston thrust per pound reciprocating weight.....	71 lb.

By an increase in unit stresses of only 10 per cent as compared with the builders' standard practice for ordinary carbon steel, and by the use of hollow bored crank pins and piston rods, and a double bushing solid back end on the main rod, a total saving of 369 lb. per side, or 13 per cent of the weight of the parts affected, was obtained. Of this, 128 lb. was in the reciprocating parts. This meant 1,880 lb. re-

duction in the dynamic augment per wheel at 73 miles per hour.

In each of the above instances of weight reductions, heat-treated forgings have been the means selected for that end. But most roads lack equipment for heat-treatment. This has been the chief obstacle to the general adoption of heat-treated forgings. It operates particularly in repair work, where for any reason the forging has to be locally heated, thereby destroying the effect of the heat-treatment. The more simple a steel and the more simple its treatment, the better adapted it is to American railroad conditions.

To meet all the special conditions entering into locomotive design, construction and maintenance, the American Vanadium Company, about five years ago, developed a type of vanadium steel that without heat-treatment other than the usual simple annealing gives all the physical requirements for heat-treated (quenched and tempered) plain carbon steel. This steel, known as carbon-vanadium, is one of the simplest types of alloy steels, being a plain carbon steel with vanadium alone added.

Tests of solid driving axles 11 in. in diameter of this type of steel, annealed, gave the following physical properties:

Elastic limit, lb. per sq. in.	59,260	60,430
Tensile strength, lb. per sq. in.	88,270	92,520
Elongation in 2 in., per cent.	25.5	24.5
Reduction of area, per cent.	48.9	50.0

Compared with ordinary annealed carbon forgings, carbon-vanadium steel has over 25 per cent higher elastic limit,

total reduction of 622 lb., or 155 lb. per wheel, in the excess balance that had to be added to the counterweights of the other wheels. This means a reduction of 3,200 lb. in the maximum rail pressure at 40 miles per hour on any one of these wheel points, assuming that all the weight saved in the reciprocating parts would be taken out of the counterweights.

By the use of vanadium cast steel for crossheads and pistons, or rolled steel pistons, and by special care in design, considerable additional weight reduction could be effected, probably 250 lb. at a very conservative estimate.

The total estimated saving in weight in the reciprocating and revolving parts through the modified designs is 921 lb. per side. Details of the redesigned piston rod, main rod and side rods are shown in Figs. 3, 4 and 5.

Apart from its relation to the dynamic augment, this weight taken out of the running gear could be added to the boiler. The above amount combined with what could be saved by using hollow bored axles of carbon-vanadium steel, would make it possible to add 1½ in. to 2 in. to the diameter of the boiler, without increasing the total weight of the engine.

In the case of the Pacific type locomotive, the results show a saving of 260 lb. in the weights of the piston rod and front end of main rod. This means 86 lb. reduction in the excess balance in the wheel counterweights, which would result in 3,900 lb. decrease in maximum rail pressure on a wheel point at diameter speed.

Piston thrust was taken as full boiler pressure times the

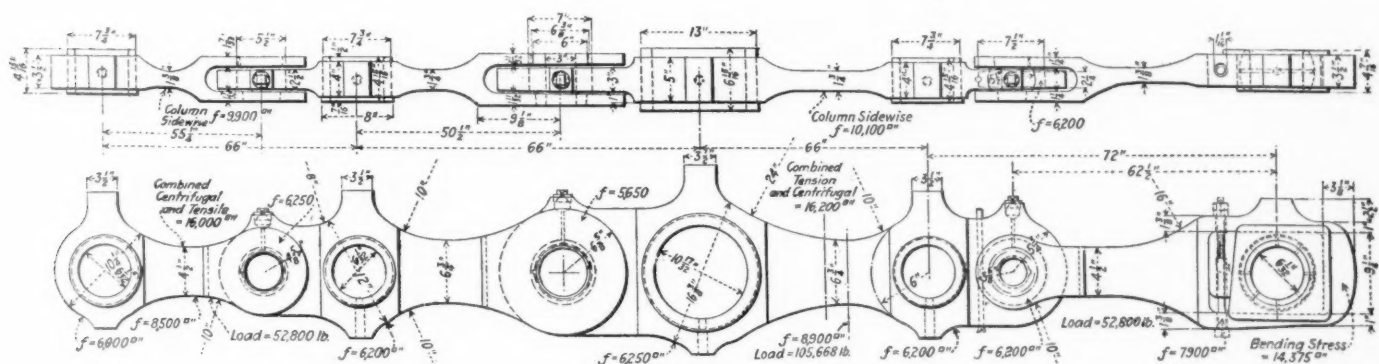


Fig. 5—Design of 2-10-2 Type Side Rods Based on Unit Stresses Increased in Proportion to Higher Elastic Limit of Annealed Carbon-Vanadium Steel

or useful strength. When higher physical properties are desired than can be obtained by simple annealing, results can be obtained by heat-treatment that approximate those from the more complex alloy steels.

A study was recently made of the amount of weight that could be saved in the reciprocating and revolving parts through an increase in unit stresses over approved practice for plain carbon steel, equal in proportion to the increase in the minimum elastic limit of annealed carbon-vanadium steel as compared with plain carbon steel. Several representative heavy locomotives were selected for investigation. The builders' adopted practice for maximum allowable unit stresses for plain carbon steel was taken as the base; and new sections worked out, keeping within the limit of 25 per cent increase over these stresses.

Two of these locomotives were the ones for which the dynamic augment curves shown in Figs. 1 and 2 were plotted. In the case of the 2-10-2 type, the results show a reduction of 326 lb. in the weight of the revolving parts on the main pin. This would mean a reduction of 6,700 lb. in the present dynamic augment in the main wheel at a speed of 40 miles per hour, due to the existing lack of 691 lb. in the main counterweight. The above saving in weight, and the reduction of 296 lb. in the reciprocating parts gives a

area of the piston. The stresses were calculated by the formulae in use by the builders.

Extended piston rods were applied to both the 2-10-2 and Pacific type. In the modified designs the extensions are eliminated. The use of the ordinary piston rod with a piston having an extended wearing shoe is considered good practice and is rapidly supplanting the use of the extended rod. Hollow bored extended rods of the Pennsylvania type could be used with almost as much saving in weight.

#### DISCUSSION

A number of members took part in the discussion. Marked advantages of the alloy and special steels in making it possible to reduce the weight of the parts, and thus the dynamic augment, were not questioned. James Partington, estimating engineer, American Locomotive Company, stated, however, that the use of these steels was not progressing as rapidly as the advantages seemed to warrant, because of the commercial and manufacturing conditions which confront the railways and the locomotive manufacturers. A number of months is now required for the delivery of the special heat-treated parts and, even under normal conditions, a much longer time is required than for carbon steel forgings. This is a bad handicap when it is necessary to replace forgings,

because of defects, in the erecting shop or in making regular running repairs. Mr. Strong, in replying to this criticism, suggested that the automobile manufacturers were using the alloy steels to the greatest possible advantage and that the difficulty in question could be overcome if the railroads would carry extra parts in stock.

W. E. Symons called special attention to the advantages of the four-cylinder compound locomotives in reducing the dynamic augment to a minimum. J. J. Yates, bridge engineer, Central of New Jersey, commented on the disastrous effect of an excessive dynamic augment upon the bridges and said that heavier wheel loads would be permissible in the proportion to which the dynamic augment could be reduced. The discussion also developed the fact that the high speed locomotives could be fairly well balanced but that the slow speed heavy freight engines were unbalanced to a very considerable degree because of the small diameter wheel and the fact that an adequate amount of contrabalance could not be provided. The use of the lighter parts would, of course, prove a very distinct advantage in such cases.

### AIR SUPPLY TO THE LOCOMOTIVE FIRE BOX

The burning of fuel is a chemical combination of carbon and hydrogen in the fuel with oxygen of the air. There can be no combustion without oxygen. Air is as necessary as fuel for the production of heat.

It is an easy matter to calculate the theoretical amount of oxygen or air required for the complete combustion of a fuel; but it is extremely difficult, if not impossible, to secure complete combustion with the calculated amount of air.

Insufficient air causes heat losses from incomplete combustion. Too much air causes heat losses in front end gases. Bituminous coal requires from 11 to 12 lb. of air per pound of coal for theoretical combustion. A saturated engine with 200 lb. boiler pressure, burning high volatile coal containing 14,000 B. t. u. per pound, will have an unavoidable front end heat loss of 11½ per cent, when 12 lb. of air is supplied per pound of coal burned. With an air supply of 16 lb. the unavoidable front end heat loss is 14 per cent.

There is an increase of 2½ per cent in front end heat loss, due to increasing the air supply from 12 to 16 lb., but this is more than offset by a reduction of from 10 to 15 per cent in the heat losses due to incomplete combustion.

Perfect combustion cannot be approximated in the average locomotive firebox with an air supply of less than 16 lb., and this amount is not sufficient if the rate of combustion is high and the firebox is not provided with a brick arch and combustion chamber. Combustion takes place only when the combustibles are brought into intimate contact with oxygen. They must be thoroughly mixed and given time to burn—particularly the volatile combustible matter that burns above the fuel bed. In addition, combustion chamber space sufficient to allow the flames to burn out before striking the flue sheet must be provided.

If no mixing device (such as the arch) is used, more air is required than otherwise. Restricted combustion chamber space and short flamework also call for an increased air supply, if the volatile matter is to be completely burned.

The best design of firebox, equipped with a brick arch and combustion chamber requires at least 16 lb. of air per pound of coal at moderate rates of combustion when burning a high volatile coal. A poorly designed firebox will require more.

It is considered good practice to provide grates with air openings equal to 33 per cent. of the grate area and ashpan openings of 14 per cent. With good run-of-mine coal and light and level firing, an air supply of from 22 lb. at low rates of combustion to 10 lb. at high rates can be se-

cured. Usually air openings of 50 per cent through grates and 20 per cent through ashpans are not too large.

The fuel bed offers sufficient resistance to prevent excessive amounts of air being drawn into the firebox. It is not necessary to throttle the air at ashpan openings or grates and thereby put unnecessary work on the draft-producing apparatus.

Insufficient air causes large heat losses, smoke, low firebox temperatures, clinkers, honeycomb, delays and engine failures. Too much air, at worst, causes increased front end losses.

Engine failures from "too much air in firebox" have not yet come into fashion.—*J. T. Anthony in the Erie Railroad Magazine.*

### RESPONSIBILITIES OF RAILROAD MEN\*

BY ROBERT QUAYLE

General Superintendent of Motive Power, Chicago & North Western

"There is a great responsibility attached to railroad men today. I sometimes think that we should stop occasionally and consider what our responsibilities are. What can we do that will make for greater efficiency, that will make for success? What will allow us to reduce the man power in our shops, to do work with less men? The man who does this now, will be the man who will stand in the forefront, because he is doing something worth while. When you have a job that you must do you respond to the call and do it. We have a big task now; let us be on the job all the time, so that we can make good at it. We are at war, let me emphasize it, we are at war, and we are just beginning to realize it. We are expecting a great deal of the railroads, but we are not going to expect too much, because railroad men are thoroughly loyal, thoroughly efficient, and will measure up to what is demanded of them. One thing you must do now and that is your level best. This is no time for pessimism, this is a time for optimism. We must cheer everyone with whom we come in contact.

"We must be loyal and give men here and there, even though we are having a hard time. Let us do our part to back up our men, that the stars and stripes may shine with more glory than ever before. Let us do our work with clean hands. Democracy must prevail—democracy will prevail! Let us as a nation do something to lift the world out of the depths it is in, that the world may rise up and call us blessed. But let us not forget those who are close to us. The men in your shops need more than knocking. It has been said that you can't saw wood with a hammer. It is just as certain that you can't lift men with a hammer. We are going to do our part if we help those about us; we are going to do our part by doing our work cheaper and better than ever before. And when the country asks more of us we are going to take another notch in our belt, and march forward, and do the best we can.

"I want to say a word about the standard locomotives. I was a member of the committee of nine that was called on to prepare these designs. It was a big job to reconcile every member of the committee to each particular thing that was adopted. All the roads represented had their own standards, and they were all different. Many had to give up the fancy notions they cherished and had to take up notions of someone else, in order that the committee might agree. As a member I want to say that each man on that committee did his job splendidly. We saw that we could not bring in localism or sectionalism; what we did had to be for the good of the nation. It was essential that we get together and do what we could to help out. It is such sacrifice that brings results, and when men are ready to give up in order that democracy may prevail, we will get results."

\*From an address before the Western Railway Club.

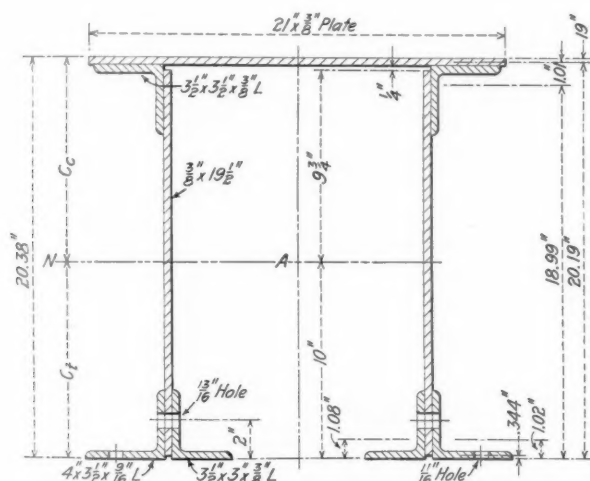
# GAR DEPARTMENT

## TABULAR METHOD FOR CALCULATING MOMENT OF INERTIA

BY WENDEL J. MEYER

The following method for calculating moment of inertia has several advantages: the component calculations are recorded and may be checked at any time; the method easily lends itself to the use of the slide rule; if the section be changed after a calculation is made, it is not necessary to make an entire new one; deductions for rivet holes are easily made.

The moment of inertia ( $I_b$ ) of a compound section about any axis or base line is equal to the sum of the moments of inertia ( $I$ ) of the component parts about axes through their own centers of gravity plus the areas ( $A$ ) of the component



Section Used as Basis for Calculations

parts multiplied by the squares of the distances ( $d$ ) from their own centers of gravity to the base line, or

$$I_b = I + A d^2$$

and

$$I = I_b - A d^2$$

Applying the latter equation to the compound section as a whole, there results:

$$I_{nn} = I_b - A_t C^2$$

where  $I_{nn}$  is the moment of inertia of the compound section about its neutral axis,  $A_t$  is its total area and  $C$  is the distance from its neutral axis to the base line.

The accompanying table shows the method applied to a center sill section. Since the section is symmetrical about its vertical center line, it is only necessary to work with half the section and then double the final result.

The sizes, areas ( $A$ ) and moments of inertia ( $I$ ) of the component parts of the section are placed in the first, second and last columns, respectively. In the third and fifth columns are placed the arms or distances ( $d$ ) from the centers of gravity of the component parts to some convenient base line, which usually will be a line through the top or bottom

fiber of the section. By multiplying the areas ( $A$ ) by the arms ( $d$ ), the moments ( $M$ ) of the areas about the base line are obtained and placed in the fourth column. A second multiplication by the arms ( $d$ ) gives the quantities  $Ad^2$  which are placed in the sixth column. The distance ( $C = 10.35$ ) from the neutral axis of the section to the base line

ORIGINAL SECTION SHOWN IN THE DRAWING

Size. In.	Area. Sq. In.	Arm. In.	Moment. In.	Arm. In.	Area x (Arm.) <sup>2</sup> In.	Mom. Inertia. In.
10.5 x .375.....	3.94	20.19	79.55	20.19	1606.1	.....
3 1/2 x 3 1/2 x 3/8..	2.48	18.99	47.10	18.99	894.4	2.9
19.5 x .375.....	7.31	10.00	73.10	10.00	731.0	232.7
4 x 3 1/2 x 9/16..	3.90	1.02	3.98	1.02	4.1	4.2
3 1/2 x 3 x 3/8....	2.30	1.08	2.48	1.08	2.7	2.7
Totals .....	19.93	(10.35)	206.21	.....	3238.3	242.5
					.....	3480.8
					206.21 x 10.35 =	2134.3
					.....	1346.5

$$C_t = 206.21 \div 19.93 = 10.35; C_b = 20.38 - 10.35 = 10.03$$

$$\text{Area} = A = 19.93 \times 2 = 39.86 \text{ sq. in.}$$

$$\text{Mom. of Inertia} = I = 1346.5 \times 2 = 2693.0 \text{ in.}$$

$$\text{Sec. Mod. (Top)} = Z_t = 2693.0 \div 10.03 = 268.5 \text{ in.}$$

$$\text{Sec. Mod. (Bott.)} = Z_b = 2693.0 \div 10.35 = 260.2 \text{ in.}$$

With 3 1/2 in. x 3 in. x 9/16 in. Angle Instead of 3 1/2 in. x 3 in. x 3/8 in.

Size. In.	Area. Sq. In.	Arm. In.	Moment. In.	Arm. In.	Area x (Arm.) <sup>2</sup> In.	Mom. Inertia. In.
Totals .....	19.93	10.35	206.21	.....	3238.3	242.5
3 1/2 x 3 x 3/8....	2.30	1.08	2.48	1.08	2.7	2.7
Differences ...	17.63	.....	203.73	.....	3235.6	239.8
3 1/2 x 3 x 9/16..	3.34	1.15	3.84	1.15	4.4	3.8
Totals .....	20.97	(9.90)	207.57	.....	3240.0	243.6
					.....	3483.6
					207.57 x 9.90 =	2054.9
					.....	1428.7

$$C_t = 207.57 \div 20.97 = 9.90; C_b = 20.38 - 9.90 = 10.48$$

$$A = 20.97 \times 2 = 41.94 \text{ sq. in.}$$

$$I = 1428.7 \times 2 = 2857.4 \text{ in.}$$

$$Z_t = 2857.4 \div 10.48 = 272.6 \text{ in.}$$

$$Z_b = 2857.4 \div 9.90 = 288.6 \text{ in.}$$

With 3 1/2 in. x 3 in. 9/16 in. Angle but with Rivet Holes Deducted

Size. In.	Area. Sq. In.	Arm. In.	Moment. In.	Arm. In.	Area x (Arm.) <sup>2</sup> In.	Mom. Inertia. In.
13/16 x 1 1/2.....	1.219	2.00	2.438	2.00	4.88	.....
11/16 x 9/16....	.387	.344	.133	.344	.05	.....
Total for holes	1.606	.....	2.571	.....	4.93	.....
Totals .....	20.97	9.90	207.57	.....	3240.0	243.6
Total for holes..	1.61	.....	2.57	.....	4.9	.....
Net totals....	19.36	(10.59)	205.00	.....	3235.1	243.6
					.....	3478.7
					205.0 x 10.59 =	2171.0
					.....	3235.1
					.....	1307.7

$$C_t = 205.0 \div 19.36 = 10.59; C_b = 20.38 - 10.59 = 9.79$$

$$A = 19.36 \times 2 = 38.72 \text{ sq. in.}$$

$$I = 1307.7 \times 2 = 2615.4 \text{ in.}$$

$$Z_t = 2615.4 \div 9.79 = 267.2 \text{ in.}$$

$$Z_b = 2615.4 \div 10.59 = 247.0 \text{ in.}$$

is obtained by dividing the sum of the areas ( $A_t = 19.93$ ) into the sum of the moments ( $M_t = 206.21$ ). The moment of inertia ( $I_b = 3480.8$ ) of the section about the base line is given by the sum ( $\Sigma Ad^2 = 3238.3$ ) of the sixth column

plus the sum ( $\Sigma I = 242.5$ ) of the last column. Subtracting the quantity  $A \cdot C^2 = M \cdot C = 206.21 \times 10.35 = 2134.3$  from  $I$ , the moment of inertia ( $I_{na} = 1346.5$ ) of the section about its neutral axis is obtained. Doubling the latter, the result for the whole section is  $I_{na} = 2693.0$ , from which all other properties of the section may be found.

If the section be changed, repeat the quantities  $A$ ,  $M$ ,  $\Sigma A d^2$  and  $\Sigma I$  from the first calculation, subtract the quantities for the component part which is to be changed, add them for the new part and proceed as before. The deduction for rivet holes is made in the same manner by treating the rivet holes as negative areas.

## HOPPER CARS BUILT BY E. J. & E.

Side Dump Type without Continuous Center Sill,  
Floor Members Designed to Take Buffing Stresses

THE Elgin, Joliet & Eastern is building in its shops at Joliet, Ill., 500 steel hopper cars. These cars are of the side-dumping type and have a rated capacity of 140,000 lb. and a cubical capacity of 2,533 cu. ft. The length over the end sills is 41 ft., the maximum width is 9 ft. 10 3/4 in. and the maximum height of the car body is 11 ft. The average weight is 57,500 lb.

One of the unusual features in the design of these cars is the method in which the floor members are made to serve as a part of the underframe. The center sills are made up of two 15-in. 40-lb. channels tied together at several points. They are not continuous from end to end, but extend only

The main floor is made up of 5/16-in. floor plates fastened to numerous transverse A-frames built up of angle bars. Along the lower edge of the floor on each side is a 3-in. by 4-in. angle and at the top ridge there is fastened a 4-in. by 4-in. 18.5-lb. 100-deg. angle. This angle extends to the bolster, while the main floor and sloping end are jointed about 2-ft. from the bolster. The end of the top angle is attached to two bent plates with angles at the lower ends, these angles being riveted to the upper flanges of the center sills. The main floor member is further stiffened by the runaway, which is a 7-in. channel, fastened to the floor by numerous pressed steel supports. There are three openings in the floor on



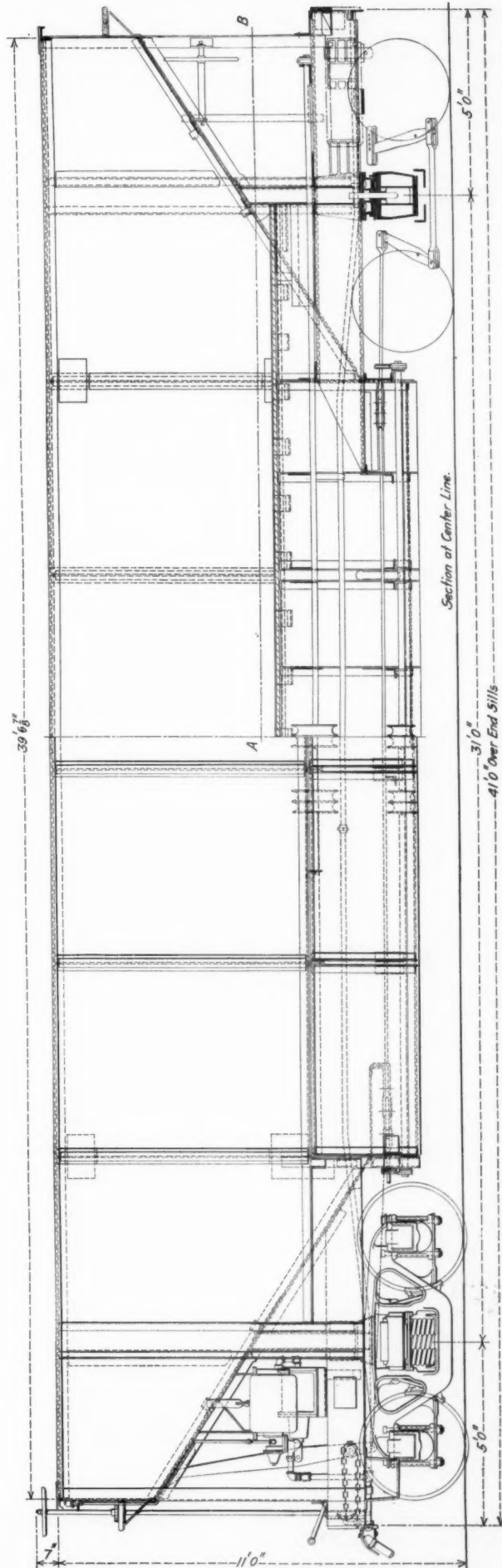
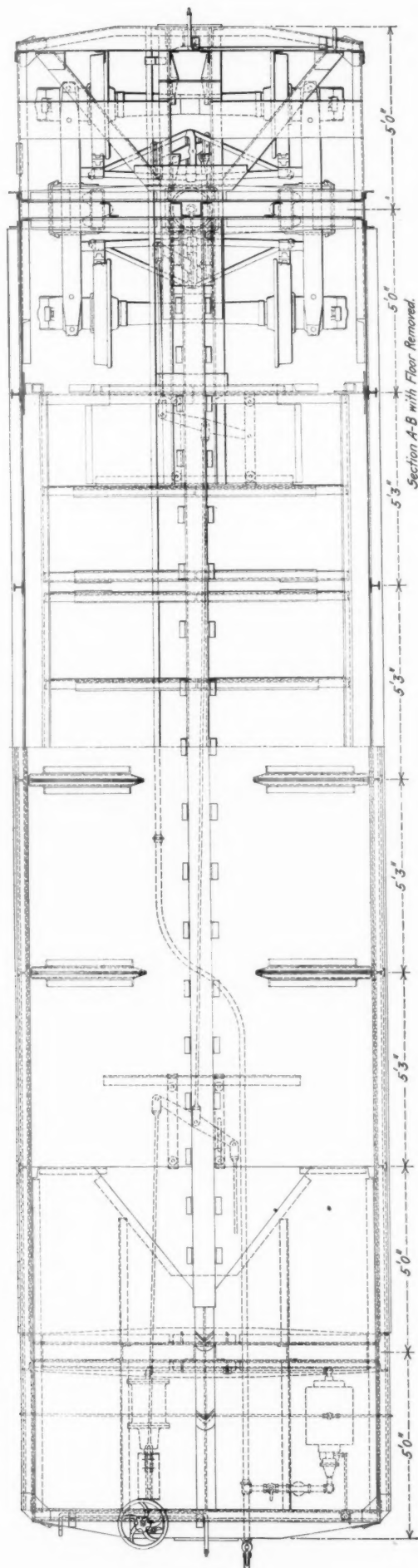
Elgin, Joliet & Eastern Hopper Car

a short distance beyond the ends of the hopper openings. The ends toward the center of the car are cut at an angle approximately the same as the slope of the floor at the ends. Each of the four channels is 12 ft. 5 9/16 in. long. At the center plate the sills pass through bolsters made up of two plates stiffened with angles and Z-bars. The end sill is built up of a 12-in. channel and pressed steel shapes. The side sills are made of 12-in. 20.5-lb. channels and extend from the end sills a short distance beyond the bolsters. The center sill channels are fastened at the inner ends to three transverse members, a 3-in. by 3-in. angle at the extreme end, a 9-in. 20-lb. channel and a 6-in. by 6-in. angle opposite the ends of the hopper doors. These members serve to transfer the stresses from the center sills to the floor members.

each side to allow the links of the door mechanism to pass through. At each of these points the floor is stiffened with angles and the plates which form the openings for the door arms are used to support gusset web plates, which serve to stiffen the sides.

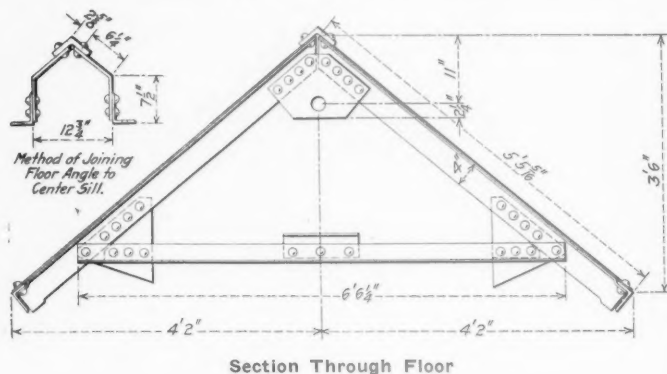
The sides are designed as girders and arranged to assist in transferring the weight of the lading to the bolsters. The top chord member is a bulb angle 4 in. by 3 in., weighing 11.9 lb. per foot, and the lower chord member is a 4-in. by 3-in. angle. The stiffeners opposite the gusset plates are cross-tie sections weighing 9.5 lb. per foot. At the ends of each bolster the sides are supported by two 2 1/2-in. by 3-in. angles.

The side plates are 1/4 in. thick, while the floor plates have

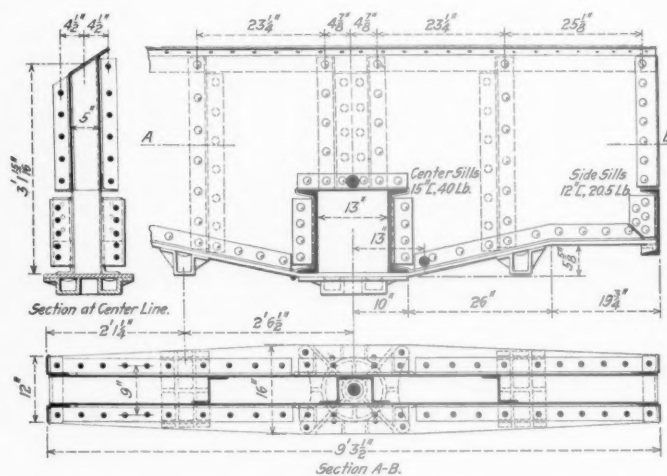


Plan and Elevation of E. J. & E. Hopper Cars

a thickness of 5/16 in. It has been found that the life of the floor and sides is about equal when these thicknesses are used. The sloping end floor sheet extends from the hop-



per up over the bolster to the end of the car, and is supported by angle irons. The vertical end plate is supported by four pressed steel end posts, in addition to the angle iron corner



The Body Bolsters of the Hopper Cars are Exceptionally Deep and Strong

posts. The end sheet is stiffened at the top by a bulb angle of the same section as that used on the sides.

The dump doors are 20 ft. 11 1/2 in. long and 2 ft. 10 1/2 in. in height. They are stiffened by angles along the top and

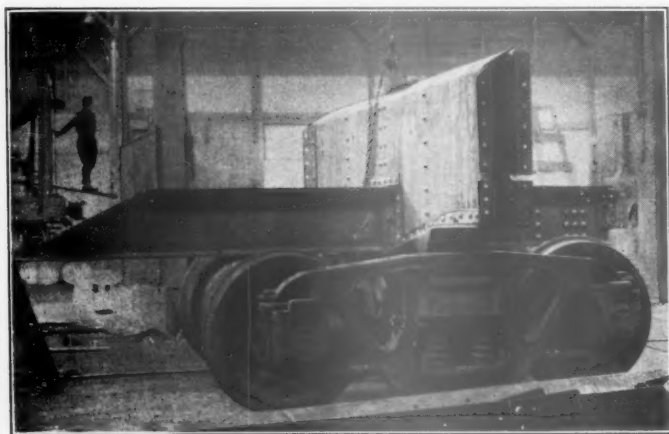


Fig. 1—Center Sills and Bolster Assembled and Placed on Truck

bottom, and at the points where the operating mechanism is attached. There are five links attached to each door, two at the ends, which pass outside the hopper opening and three at intermediate points, which pass through openings

in the floor. The links are connected to arms on shafts carried under the sides of the floor. The links are bent so that they have a toggle action, and are self-locking when the doors are in the closed position. The shafts which control the operation of the doors are attached to the main operating



Fig. 2—Main Floor Member Being Assembled. Note Extension at End for Attachment to Center Sills

shaft by chains. Two turnbuckles are placed in each chain to allow the position of the shaft to be adjusted so that both doors will close together. The main operating shaft extends under the floor to the end of the car, and is controlled

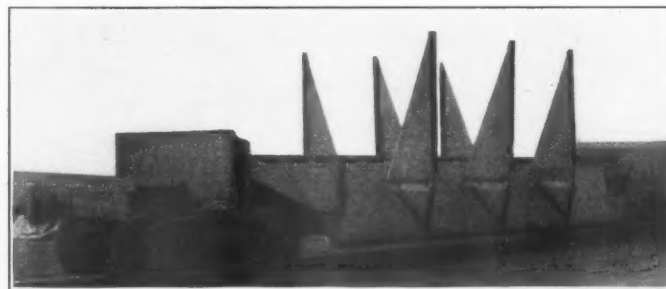


Fig. 3—Ends and Floor Section Assembled and Side Gusset Straps in Place

by a hand wheel and chain attached to an arm on the end of the shaft. The arrangement of the dumping mechanism is clearly shown in one of the illustrations.

The trucks used under these cars have Andrews cast steel

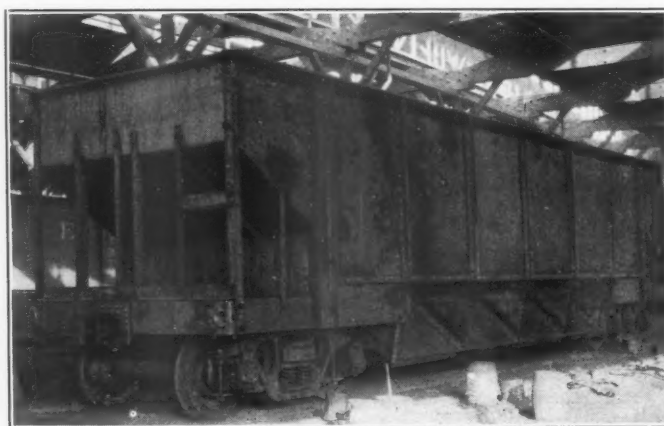


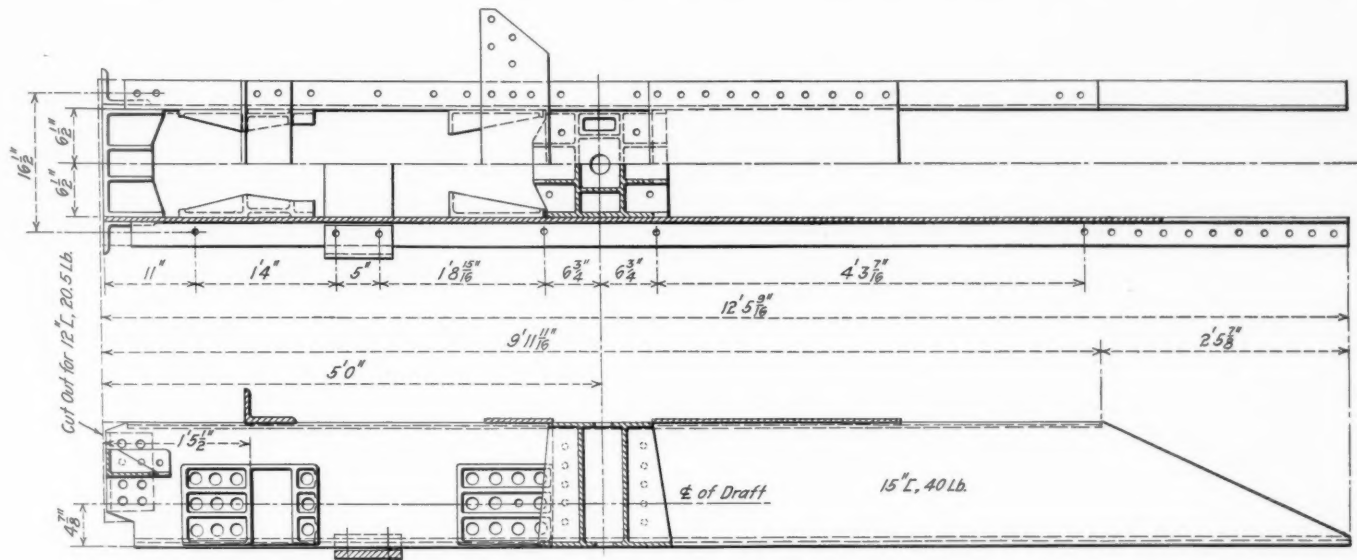
Fig. 4—Sides and Ends in Place Ready for Application of Doors and Appliances

side frames, rolled steel wheels, and Simplex truck bolsters. Ajax brake beams conforming with the M.C.B. specifications for No. 3 beams are used. A brake rigging safety hanger similar to the type previously described in the *Railway Mechanical Engineer*\* is also used on these cars. In

\*See issue of August, 1917, page 448.

the present design, however, an additional feature has been incorporated in this device. A portion of the upper end of the hanger is bent down horizontal, so that it extends over the compression member of the brake beam and serves to pre-

venting the work of construction are novel and interesting. Practically all the building is done on a single track, which passes through the repair shed. This track has been fitted up especially for building cars. The trucks are assembled at

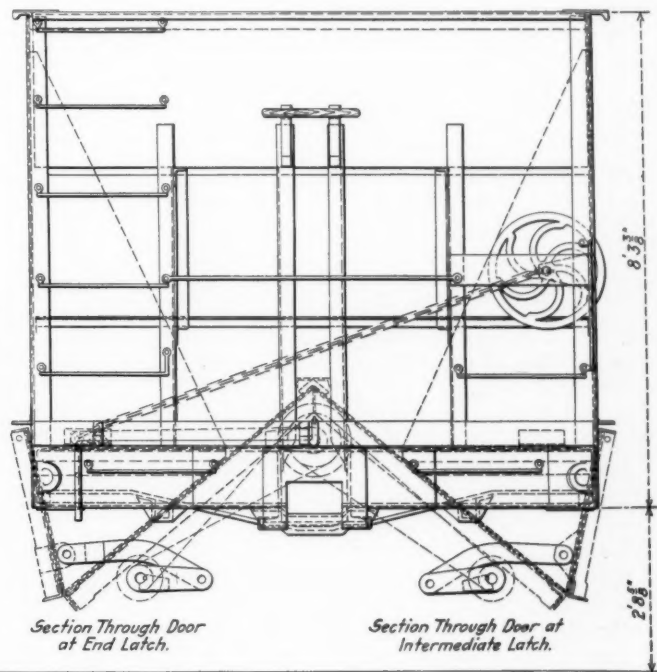
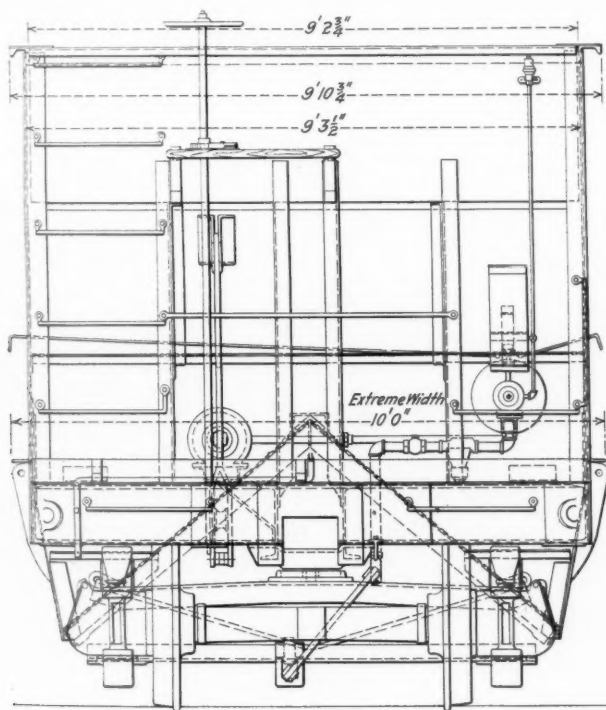


Short Center Sills Used in E. J. & E. Hopper Car

vent the beam from tipping. An extension is provided under the spring plank to prevent the hanger from being raised. The new design is clearly shown in one of the illustrations.

The couplers used on these cars are the M.C.B. type D, No. 5, with 6-in. by 8-in. shank and 9 1/8-in. butt, attached to the yoke with a key. The yoke is of 1 1/4-in. by 5-in.

one end and, as they are required, are rolled to the point where the cars are erected. The smaller parts, such as the plates, gussets, angles, center sill channels, etc., are prepared in the steel shop. Many of the methods used in this department have already been described in these columns.\* The finished parts are stored until needed and are carried to the



Plan and Elevation of E. J. & E. Hopper Cars

wrought steel. The draft gear is the Miner type A-18; Westinghouse air brakes are used with K-2 triple valve, and a 10-in. by 12-in. air cylinder.

#### METHODS USED IN BUILDING THE CARS

These cars are being built in the company's shops at Joliet at the rate of 100 cars a month. The methods used in han-

erecting shop on hand cars. A narrow gage track adjacent to the erecting track is used only for the delivery of material.

When starting the work on a car two trucks are first rolled into position, the space left between them being somewhat greater than the length of a car. The material for the

\*See Railway Mechanical Engineer, issue of October, 1917, page 563.

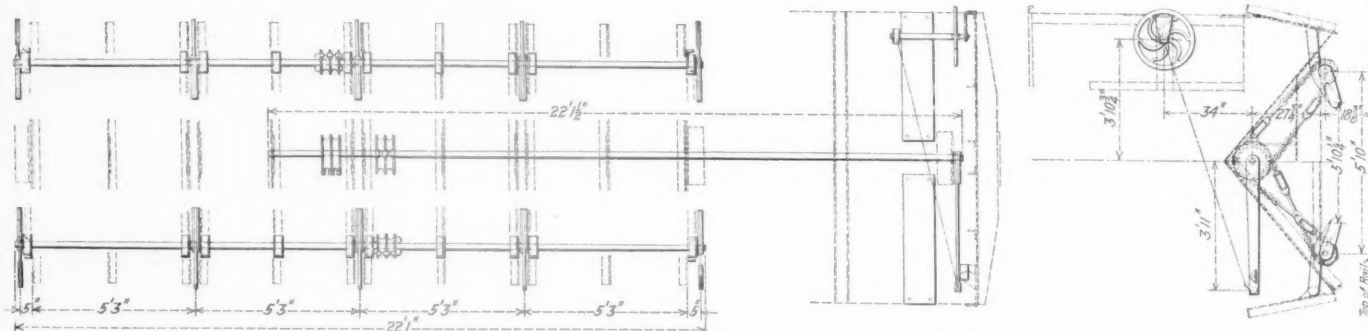
center sills and bolsters is placed next the trucks, with the parts for the main floor members between. The two center sill channels, bolster, side bearings and center plate are assembled on horses. When completed these units are raised by a chain hoist and lowered onto the trucks as shown in Fig. 1.

The A-frames for the floor members are bolted to the angles extending along the side of the floor and the floor sheets, dump arm covers, and top angles are riveted into place (see Fig. 2). The floor section is then raised by chain hoists,

and an M. C. B. billing force will still be required.

The writer has given this matter consideration and would be in favor of the abolition of charges for repairs, if an equitable substitute were offered whereby the spirit of M. C. B. Rule No. 1 could be kept alive, but cannot become reconciled to the fact as it appears, that by removing the charges for repairs to the "other fellow's equipment," it must follow that the incentive to maintain care as required by M. C. B. Rule No. 1, is removed.

Under Government control, practically all of the railroads



Arrangement of Door Operating Mechanism for the Elgin, Joliet & Eastern Hopper Cars

the center sills and bolsters are rolled into place and riveted to the floor members. The end sills, couplers and side gusset plates are next applied as shown in Fig. 3, and the sloping ends of the floor are put in place.

The sides are assembled on horses, together with the side sills. When finished they are hoisted by chain blocks suspended from trolleys running along both sides of the track. The partly finished car is run down the track between the sides, and they are hoisted to position and riveted in place. The ends are then applied and the car is ready to be run to another track for the application of the hopper doors, door-operating mechanism, brake rigging, etc. Although only one track is used for the main erecting operations, no difficulty has been experienced in keeping up an average output of five cars per day.

## SHOULD THE MASTER CAR BUILDER'S REPAIR CARD BE ABOLISHED DURING THE PERIOD OF THE WAR

BY E. A. SWEETLEY  
Master Car Builder, Seaboard Air Line

It has been suggested by various mechanical and operating officers that during the period of federal control of the railroads, the M. C. B. code of interchange rules be suspended and used merely as a reference as to what defects or conditions constitute a menace to safe operation and that charges for repairs to equipment, which under the individual ownership were considered foreign, be discontinued.

The suggestion is one that is worthy of consideration by all operating officers, and to carry it out successfully a plan must be devised whereby it would be found practicable to discontinue the "swapping" of repair cards and still keep alive the spirit of M. C. B. rule No. 1, which reads as follows: "Each railroad company must give to foreign cars while on its line, the same care as to inspection, oiling, adjusting and repairs, that it gives to its own cars."

In recommending the abolition of the M. C. B. repair charges, some thought must be given to the repairs which it will be necessary to make to cars of private lines and short lines, which are not under government control, and the equipment of Canadian and Mexican Railroad companies. A portion of the equipment handled will be in this class and the handling of this equipment will necessitate repairs

are being operated as a unit. The principal object of the railroad officers is to help win the war, but at the same time the fact remains that the railroads are private property, borrowed by the government to help win the war, and there is no doubt that it is the intention of the government to return this property to the owners in at least as good condition as when borrowed. This, it is believed, will not be the case, if the charges for repairs are eliminated.

It would appear to the writer, after studying this matter from every angle, that it would not be to the best interest of the railroads, or of the government itself, to eliminate the charges for repairs to freight cars, other than those owned by the road making the repairs.

As all of the discussions which have thus far been held in regard to the elimination of charges for repairs to freight cars were made with the end in view that man power be conserved and expenditures cut down, the thought has offered itself that the most practical solution to this problem would be to establish regional billing departments, having a number of such departments to act as clearing houses in convenient locations in different parts of the country and have the repair cards for all railroads sent to the various clearing houses. The repair bills could be made up monthly as they are now handled in the auditing departments of the several railroads and an annual adjustment of the repair bills between the several railroads could be made.

This plan would divert to other fields of occupation, many men and women who are now engaged in preparing M. C. B. bills, checking cars, auditing bills and preparing vouchers. In addition to this a large amount of stationery would be saved annually and the spirit of M. C. B. rule No. 1 would be preserved intact.

WAKE UP!—Thus far we are certain, the Germans haven't invented any long range gun that will carry across the Atlantic. But it would require such a gun to awaken some Americans to the realization that we are in this war—*Utica Herald-Dispatch*.

BRITISH AMBULANCE TRAINS FOR THE U. S. ARMY.—The Great Western of England has supplied 104 locomotives and over 4,000 cars for the railways overseas. It is building two ambulance trains for the United States troops in Europe. Altogether fifteen such trains are being, or have been built by British railways.—*The Engineer, London*.

# STANDARD STEEL SHEATHED BOX CAR

**Specifications and Designs Similar to Other Box Cars, Wood Lining Provided on Sides and Ends**

THE Railroad Administration issued early in April specifications and drawings for a 50-ton steel frame, steel sheathed box car having an estimated weight of 46,000 lb. Since that time, however, representatives of the War Industries Board, the Shipping Board and the Railroad Administration, meeting in joint conference, decided that the Shipping Board, the Army and the Navy will have priority over the railroads in their requirements for steel.

mentioned above. This car is to be carried on the standard 50-ton truck and has the following general dimensions:

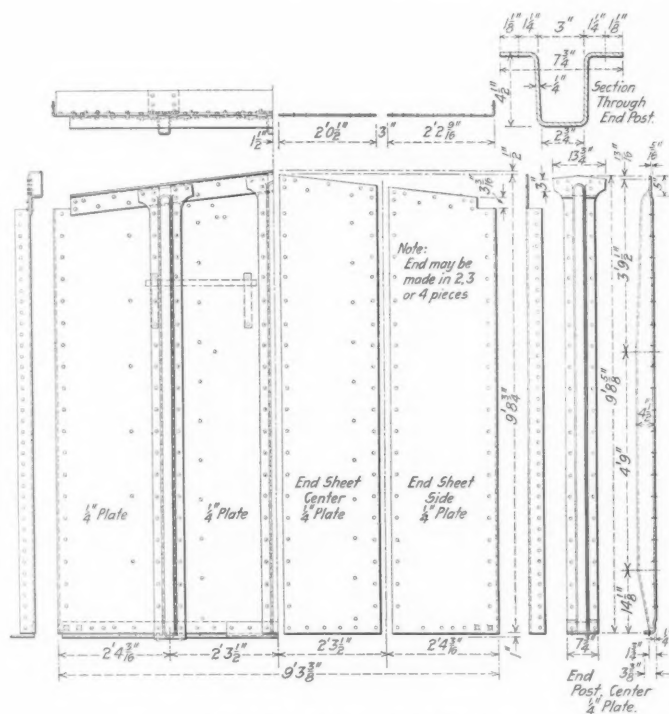
Length inside .....	40 ft.	7½ in.
Width inside* .....	8 ft.	6 in.
Height inside* .....	9 ft.	0 in.
Length over striking plate* .....	42 ft.	1½ in.
Width over roof sheets .....	8 ft.	8½ in.
Width over side plates .....	9 ft.	4 in.
Width over all .....	10 ft.	0 in.
Height from rail to top of car at eaves .....	12 ft.	9 in.
Height from rail to top of brake mast .....	14 ft.	2½ in.
Height from rail to top of running board .....	13 ft.	7¾ in.
Distance center to center of trucks* .....	31 ft.	1½ in.
Height from rail to center of coupler* .....	2 ft.	10½ in.
Height from rail to bottom of center sill* .....	2 ft.	4½ in.
Estimated weight .....	46,000	lb.

\*These dimensions are common to the other box cars.

*Underframe.*—The underframe is very similar to that used for the single sheathed box car, having 12-in. channel center sills with a 20½-in. by ¼-in. cover plate, 9-in. channel side sills, ¼-in. pressed steel floor supports, pressed steel diaphragm bolsters and 5/16-in. pressed steel corner braces. The crossbearers are the same, with the exception of the cover plates, which are slightly heavier for these cars. The end sills are 6-in. by 4-in. by ¾-in. angles, on the outside of which is riveted the steel end. The draft sills are practically identical with those of the other box cars, the only change being in unimportant details made necessary for supporting the steel sheathing of the car. On account of the similarity in the designs of the underframes a reproduction of the underframe for this car is not shown.

*Superstructure.*—The designs for this car call for a  $\frac{1}{8}$ -in. steel sheathing with a  $\frac{13}{16}$ -in. lining at the sides and ends, and a steel roof of  $\frac{3}{32}$ -in. plates. The same designs of steel ends are permitted as for the other box cars. The side framing is well illustrated in the view showing the general plan of the car body. There are six pressed steel posts on each side of the car made from  $\frac{1}{4}$ -in. plate. These are 8 in. wide and  $3\frac{1}{2}$  in. deep. In addition to these there are eight 3-in. by  $3\frac{1}{2}$ -in. wooden side posts to which is nailed the inside lining. The end posts for the plain end construction, which are shown in one of the illustrations, are pressed from  $\frac{1}{4}$ -in. plate and are  $7\frac{3}{4}$  in. wide by  $3\frac{3}{4}$  in. deep. The corner posts are of wood. The side plates are 4-in., 10.3-lb. Z-bars, to which are riveted the side sheathing and the roof sheets. The end plate is a 5-in. by 3-in. by  $\frac{5}{16}$ -in. angle.

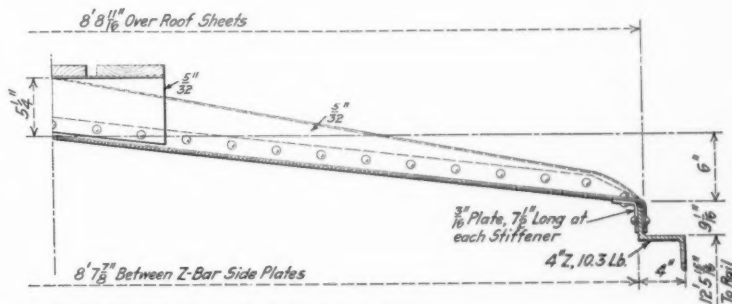
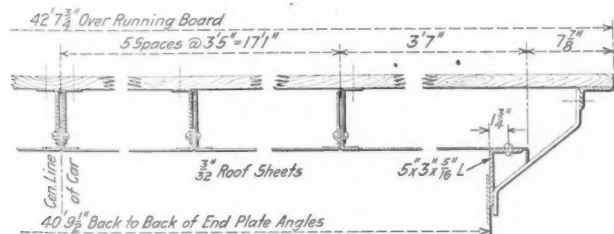
There are two designs of roof permitted, that shown in



### Plain Steel End for the Standard Steel Box Car

As a result the all-steel box cars, which are described below, will not be built at this time and less steel than was originally planned will be used in other types of cars.

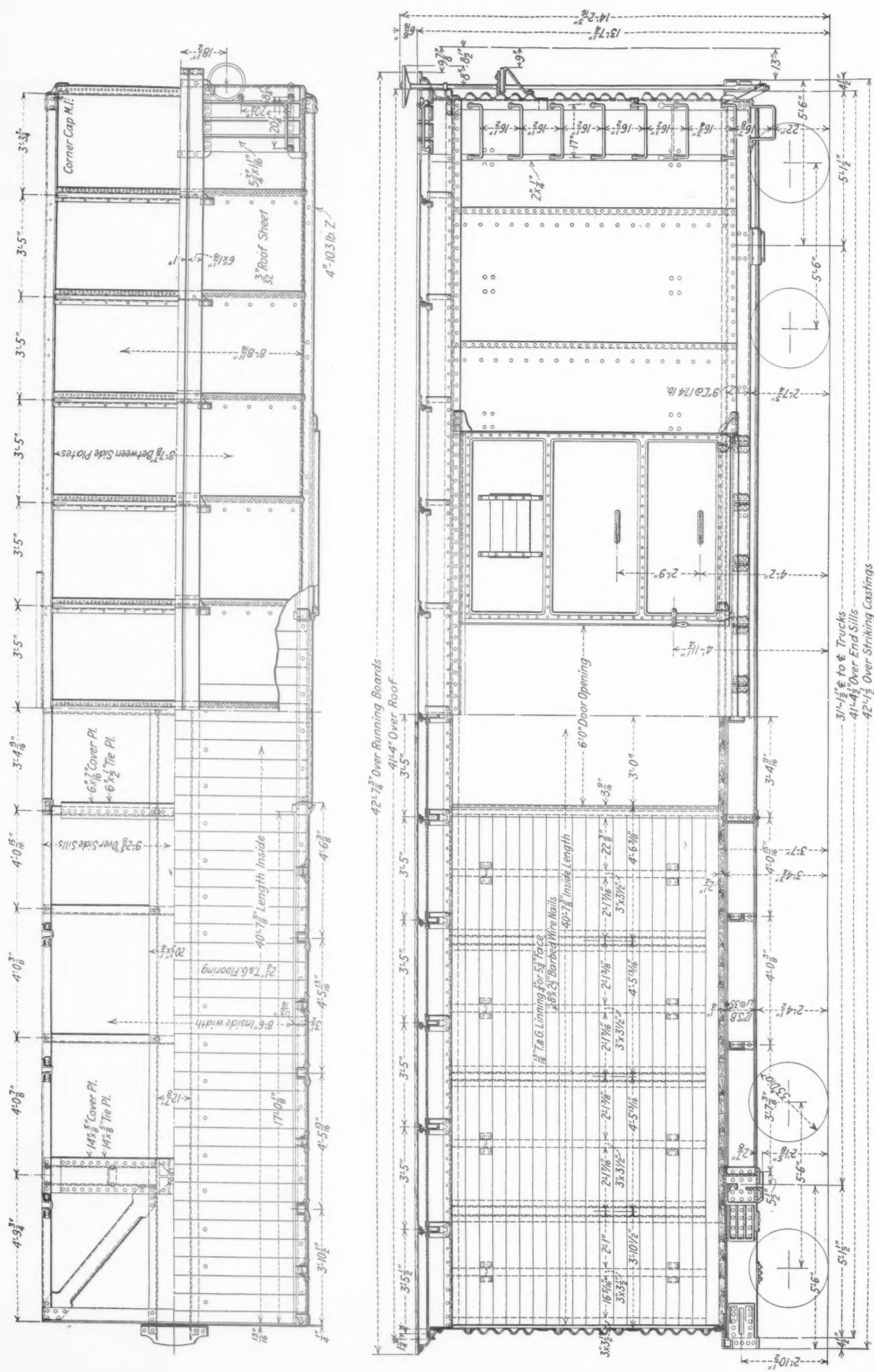
The details of the steel-sheathed box cars are as nearly as possible the same as the other standard box cars, which were described on page 189 of the April issue. The under-

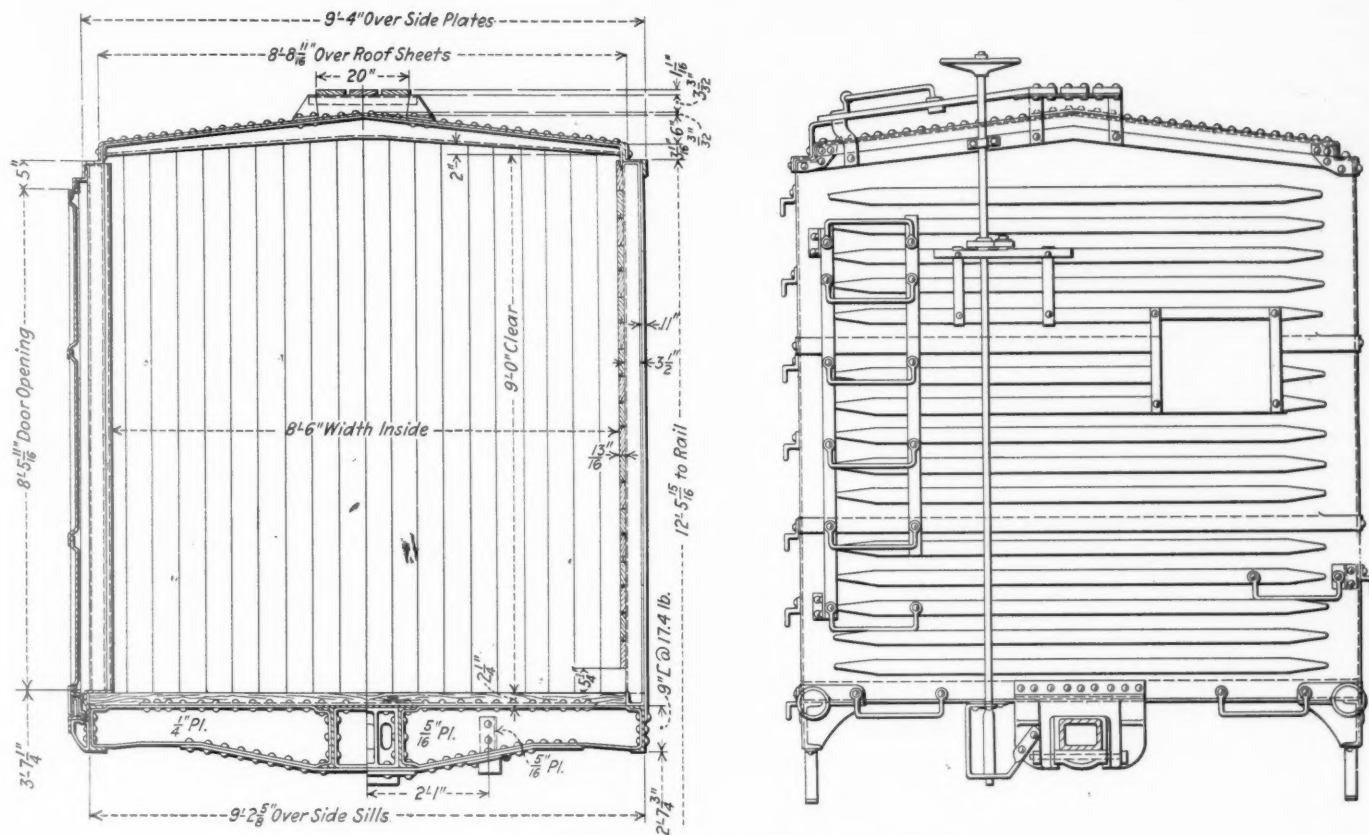


### One Type of Roof Construction Permitted on the Steel Sheathed Box Car

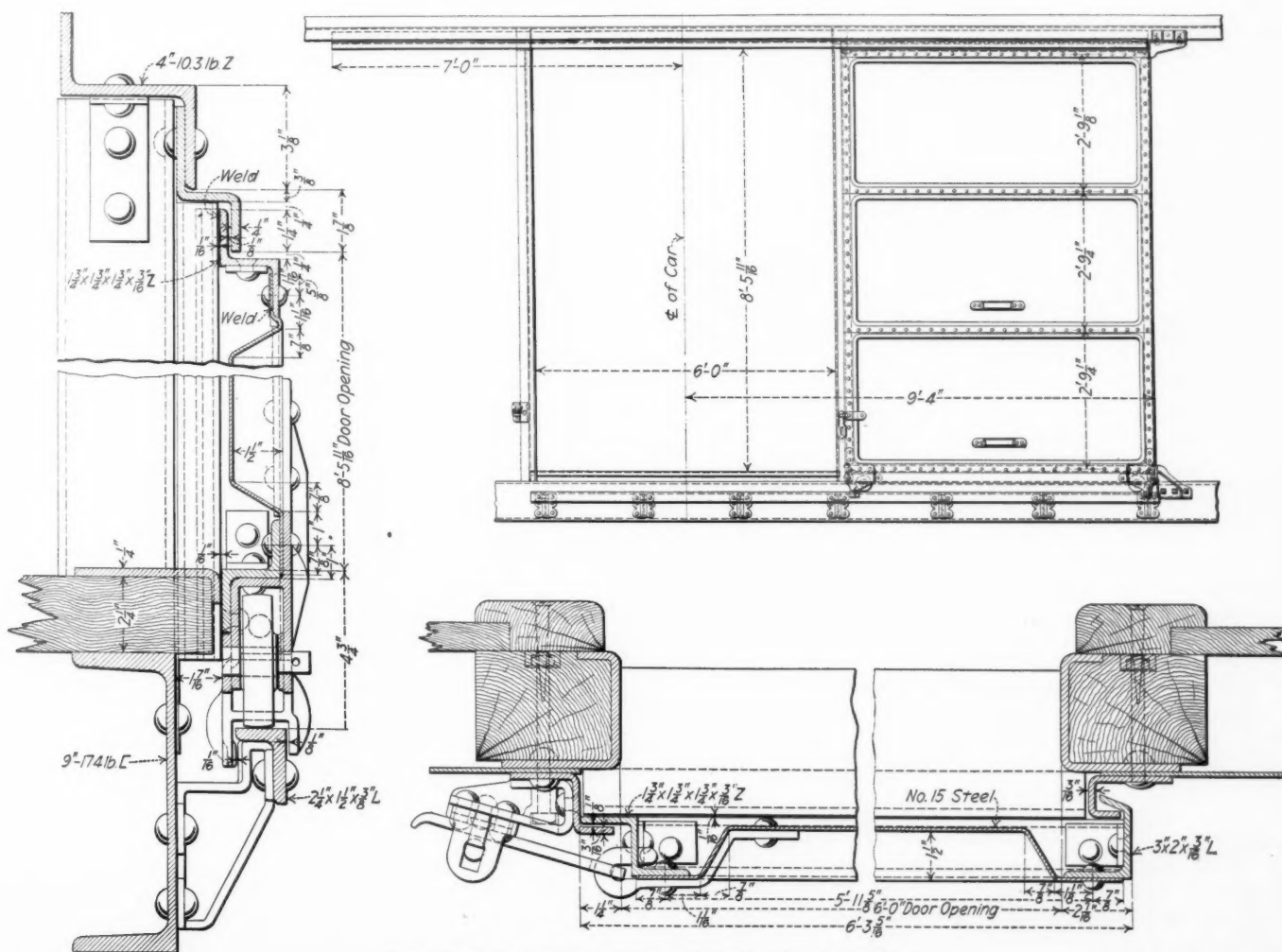
frame is practically a duplicate of the single sheathed car, several of the door details are the same and the draft sill is the same with the exception of minor changes necessitated by the design of the car. The body specifications are the same as those for the box cars described in the article

the general plan and one shown in the roof section which has been reproduced. In both cases a 3/32-in roof sheet is required. A pressed steel carline is used on the arrangement shown in the general plan and the running board is supported by angles bolted to a pressed angle curved to con-





Section and End Views of the Standard Steel Box Car



Steel Door for the United States Standard Steel Box Car

form to the contour of the roof. In the other plan the roof sheets are supported by outside carlines pressed from 5/16-in. steel, which also support the running board.

An all-steel door of the underhung type is used, providing an opening 6 ft. wide by 8 ft. 5-11/16 in. high. This door is made up of three pieces of No. 15 gage steel, pressed as

indicated in the drawings. The door framing is made up of a 1 3/4-in. by 1 3/4-in. by 1 3/4-in. by 3/16 in. Z-bar at the front, top and bottom, and by a 3-in. by 2-in. by 3/16-in. angle at the back. The rollers are carried on a 2 1/4-in. by 1 1/2-in. by 3/8-in. angle. There are many of the details of the door common to the doors used on the other box cars.

## FREIGHT CAR AND TENDER TRUCK BOLSTERS

### An Explanation of the General Principles Involved in the Design, Loading and Testing of Truck Bolsters

BY G. S. CHILES AND R. G. KELLEY

#### PART II\*

IT will be recalled that the value of the section modulus as derived from the formula from which curve 8 of Fig. 3 was plotted was slightly less at the side bearing in all three examples of side bearing spacing and that it was considerably less toward the center of the bolster. At some points, as for example, in the region from 17 in. to 23 in. from the supports, in the case where the spread of the side bearings was assumed to be 50 inches, the section modulus as derived from the formula is greater than that which obtains from the use of the method which requires that the bolster be designed to carry either the entire load at the center plate or one-half of the load at the center plate and one-half at either side bearing. The fibre stress for this combined method of loading was limited to a value of 9,000 pounds per square inch as compared with 12,500 for the formula method. Varying the fibre stress of either method would alter the required section modulus but would not affect the general slope of the diagrams to any appreciable extent.

Having considered the loads reactions, bending moments, etc., incident to the design of bolsters along practically the same lines followed in the design of the M. C. B. axles, a study of Fig. 9 may bring out some points of interest. In this figure, diagrams 1 and 8 are the same as those shown in Fig. 3, the former being plotted for a center plate load of 73,000 lb. and an allowable fibre stress of 9,000 lb. per sq. in. and the latter for a center plate load of 73,000 lb. and an allowable fibre stress at the center of 12,500 lb. per sq. in. A curve similar to curve 8 may be formed by assuming a load of 73,000 lb. to act at the center plate and by reducing the 12,500 lb. fibre stress at the center and at the points of support, the stress approaches a limiting value which is only one-half the value at the center or 6,250 lb. per sq. in.

Diagrams 13, 14 and 15 of Fig. 9 are derived from the bending moment diagrams of the corresponding numbers plotted in Figs. 7 and 8. It will be remembered that the vertical load was increased 26 per cent in order to compensate for vertical oscillation and that a horizontal force equal in amount to 0.4 of this total load was assumed to act at a point 72 in. above the top of the rail. In plotting the section moduli diagrams for the bending moment diagrams 13, 14 and 15, it was decided to employ a fibre stress which would give a section modulus at the center of the bolster approximating that of formula 8 and it was found that a working fibre stress of 18,000 lb. per sq. in. would meet this requirement inasmuch as the resulting section modulus for diagrams 13, 14, 15 would be 123.8, 111.7 and 107.9 respectively, as compared to 112.4 derived from the formula used in plotting diagram 8. Those sections of

these diagrams which are included between the center line of the bolster and the points where they intersect diagram 1, are drawn in with broken lines in order to emphasize them and to bring out more clearly the contrast between them and diagram 1.

In case of the side bearings having a spread of 50 inches, the value of the section modulus at the side bearings would be 76.4 according to diagram 13, whereas it would be 65.0 according to the formula of diagram 8. For the 60-in. spacing, diagram 14 requires a section modulus of 45.4 as against 44.2 for diagram 8. For the 64-in. spacing the value of the section modulus according to diagram 15 is 34.1 while according to diagram 8 it becomes 34.7. Thus a bolster having a 50-in. side bearing spacing, designed in accordance with the formula employed in plotting diagram 8 and based upon a fibre stress of 12,500 lb. per sq. in., would be subjected to a fibre stress of 21,150 lb. per sq. in. at the side bearing under a loading such as that assumed in designing axles.

Similarly, the fibre stress at the side bearing would reach

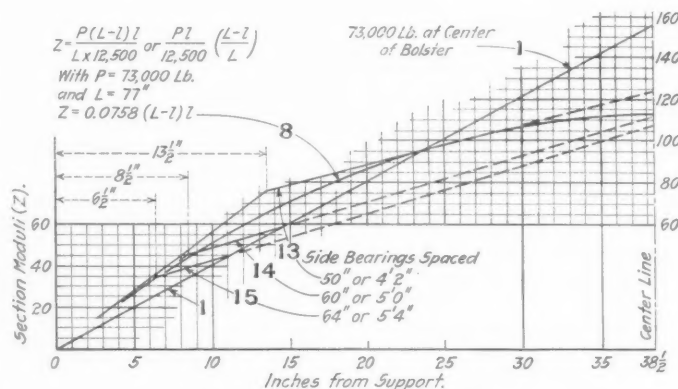


Fig. 9—Section Modulus Diagram

a value of 18,500 lb. in the case of the 60-in. side bearing spacing and a value of 17,650 lb. in the case of the 64-in. spacing. The design of M. C. B. standard axles is based upon a working fibre stress of 22,000 lb. per sq. in., but as it is questionable as to whether bolsters are ever subjected to any such loading in actual service as that assumed by the 1896 M. C. B. Axle Committee, it may be of interest to consider briefly the method of reasoning by which they reached their conclusions.

In the course of a series of experiments with four wheel cars on the Prussian State Railways, Wöhler ascertained that the weight on the journal was increased about 37.5 per cent by the forces set up by the vertical oscillations of the car, thus making the resulting maximum load 137.5 per cent of

\*The first part of this article appeared in the April *Railway Mechanical Engineer*, and for greater convenience the figures are numbered consecutively from the beginning.

the normal weight. The M. C. B. Committee on axle design referred to above, endeavored to confirm Wöhler's results by experiments with the ordinary type of eight wheel cars in service on American Railways. A thirty-ton capacity box car, equipped with the Fox type of truck was selected and the total static or normal load carried at each axle above the springs was determined and found to be 23,588 pounds or 11,794 pounds per spring. The springs were calibrated, a recording mechanism which would register the maximum compression of the spring applied, and the car was then run over the Pennsylvania Railroad from Renova, Pa., to Canandaigua, N. Y., and return, a total distance of 398 miles. As the result of the observations made during this test run, it was found that the average maximum com-

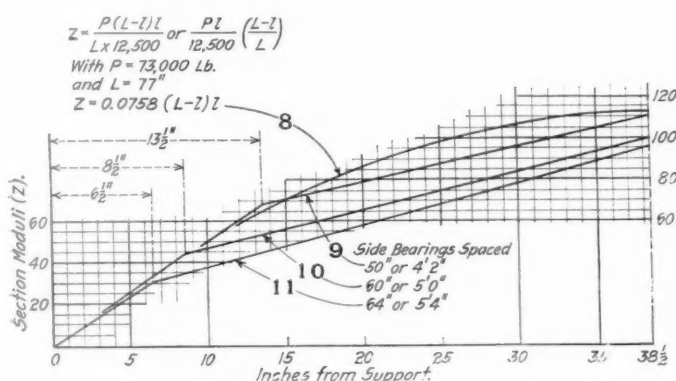


Fig. 10—Section Modulus Diagram Based on Bending Moments of Fig. 5

pression of the eight springs was 19,469 lb. or 167 per cent of the normal load and that the maximum compression for any one spring was 23,403 lb. or 198 per cent of the normal load.

The value of the horizontal force equal to 0.4 the vertical static load or center plate load, was found to be sufficient to almost entirely relieve the weight on one rail, i. e., to almost overturn the car. This value of the horizontal force was therefore accepted as the maximum value; the maximum calculated pressure on one spring due to the combined static load, and this assumed horizontal force is equal to 18,573 lb. The difference between this maximum calculated pressure of 18,573 lb. and the maximum compression of 23,403 lb. measured on one spring during the experimental trip, or 4,830 pounds, was regarded as being due to the vertical oscillation which is equal to 41 per cent of the static load on each spring. This would not necessarily be the actual vertical oscillation, but it was considered to be the value of the maximum vertical oscillation when the horizontal force was a maximum. The moments obtained by the above method (Reuleaux) provided for an axle larger in diameter in the center than the method wherein the load is assumed to be 198.4 per cent of the normal load, while the method which takes into consideration the action of a horizontal force equal in amount to 0.4 the vertical static load, provides for a larger diameter both at the wheel seat and also at the center of the axle, than would be the case, were all the registered spring load, less that due to the static load, considered as being due to vertical oscillation. Such would not be the case, as regards the bolster.

If all the registered spring load is assumed to be due to vertical oscillation, the resulting static load would be 198.4 per cent of the normal load and the bending moment at the center of the bolster would be 198.4 per cent of the normal moment. Assuming an allowance of 26 per cent of the static or center plate load for vertical oscillation and a horizontal force equal to 0.4 this value, as was the case in plotting diagrams 13, 14 and 15 of Figs. 7 and 8, the per cent of increase in the bending moment at the center of the

bolster, will be found to vary from 138 to 159 per cent of the normal bending moment. These values are tabulated in the third or lower line of Table II.

Table III is abstracted from a paper entitled "Some Experiments to Determine the Force on a Truck Side Frame and Stresses Produced by these Forces," which was delivered before the Railway Club of Pittsburgh, Feb. 22, 1915, by Professor Louis E. Endsley of the University of Pittsburgh.

In these tests, the truck springs of the Pennsylvania standard H-21 Hopper Car were calibrated and a record made of the maximum compression of the springs under each end of the bolster, this maximum pressure for each test is tabulated in column 5 of Table III. The maximum direct vertical pressure in per cent of the normal load, is recorded in column 6; these values being obtained by dividing the values of column 5 by those of column 4. It will be noted that this

TABLE III—RESULTS OF TESTS TO DETERMINE THE MAXIMUM VERTICAL PRESSURE COMING ON TRUCK SIDE FRAME

Test	Kind of service	Load on car	Normal load on truck side frame	Maximum pressure on side frame	Maximum load in per cent of normal
1	Local	None	8,175 lb.	16,400 lb.	200.
2	Local	None	8,175 lb.	15,800 lb.	193.
3	Local	66,000 lb.	24,675 lb.	52,800 lb.	214.
4	Local	66,000 lb.	24,675 lb.	45,000 lb.	182.
5	Through freight	91,000 lb.	30,925 lb.	66,600 lb.	216.
6	Through freight	91,000 lb.	30,925 lb.	76,000 lb.	246.
7	Through freight	91,000 lb.	30,925 lb.	60,000 lb.	194.

maximum load ranged from 182 per cent to 246 per cent of the normal.

In the course of three of the round trips between Pittsburgh and Alliance, the Standard M. C. B. springs which are designed to go solid at 64,000 lb. went solid several times during each trip of eighty (80) miles. The load on the truck side frame during these tests was 30,925 lb., so

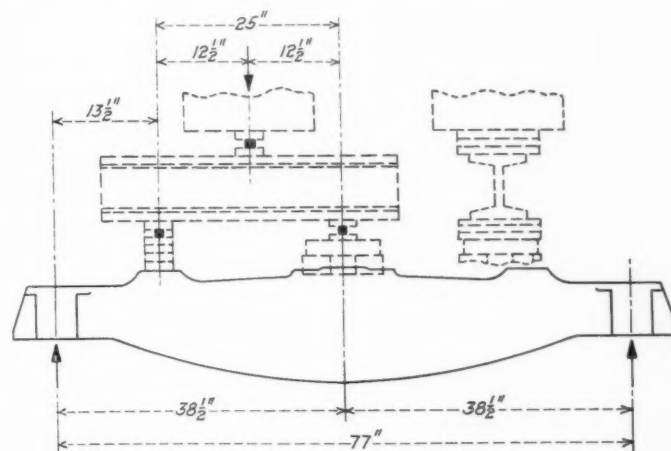


Fig. 11—Method of Loading Bolster for Test

that a force of over 207 per cent of the normal load was not uncommon. Four new sets of springs, having a capacity of 104,000 pounds were then substituted and the results obtained during three additional round trips are set down in the last three lines of Table 3, the data for the first four tests recorded in this table being obtained when the car was equipped with the 64,000 lb. capacity springs. Prof. Endsley called attention to the fact that the results indicated very clearly that the standard 100,000 lb. capacity M. C. B. springs do not have sufficient capacity, as the forces of over 70,000 lb. were not unusual with a normal load of 30,925 lb. on each frame.

As the maximum load exceeded 216 per cent of the normal load in one test only, being 246 per cent in test No. 6, Prof. Endsley concluded that a load equal to 220 per

cent of the normal load on the frame would be a conservative figure for the design of a freight car truck.

The maximum loads in per cent of the normal loads determined by the experiments conducted by Prof. Endsley, which are tabulated in column 6 of Table III, should be compared with the percentages given in Table I, since they both represent the reactions at the end of the bolster in terms of the normal load. For a vertical or center plate load of 73,000 lb. and a horizontal force equal to 0.4 of this load or 29,200 lb. assumed to act 46 in. above the center bearing, the maximum calculated reactions are 205 per cent, 209 per cent and 221 per cent of the normal reactions respectively, the greater value being that for the 50-in. side bearing spacing. As previously pointed out, in order to design a bolster, it is essential not only to know the maximum reaction to which it will be subjected, but also to know what per cent of this reaction will be due to vertical oscillation. If the reaction at each end of the bolster were recorded simultaneously, then it would be possible to determine the exact relation between the vertical oscillation and the horizontal force, both as regards the amount and also the time of action, but until such experimental data is obtained, it is necessary to assume some such relation. Since the system of loading which deals with a combination of center plate load of 73,000 lb. and a horizontal force equal to 0.4 of the center plate load or 29,000 lb., acting through an arm of 46 in., sets up reactions which approximate those of Prof. Endsley's experiments, we have, in view of this fact, constructed section modulus diagram, Fig. 10, which is the same general type as Fig. 9. In determining the section moduli, the values for the bending moments of Fig. 5

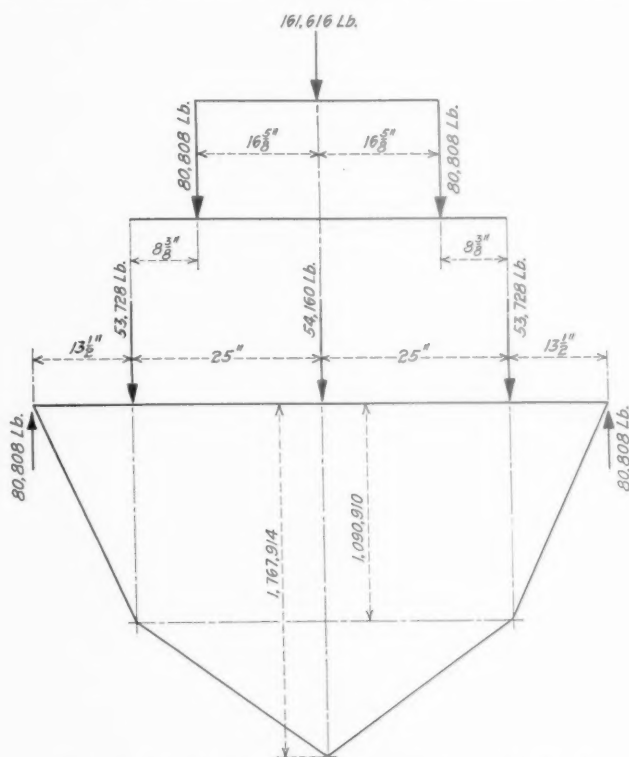


Fig. 12—Bending Moment Diagram Shown at 9, Fig. 5

were used and diagrams developed for the three side bearing spacings, the numbers 9, 10, 11 referring to the bending moment curves of Fig. 5 of the same number.

As was the case in constructing the diagrams of Fig. 9, which were based upon an assumed fibre stress which would provide for a section modulus at the center of the bolster approximating the same as that obtained by use of the formula used in plotting diagram 8, a fibre stress was assumed in order to plot 9, 10 and 11 of Fig. 10. It was found that

with a fibre stress of 14,000 lb. per sq. in., the section moduli at the center of the bolster were 126.3, 114.0 and 110.1 for the three side bearing spacings as compared to 112.4 by the formula in which a 12,500 lb. stress was used. The reaction for the bolster subjected to the combined action of a direct center plate load of 73,000 lb. and a horizontal force equal in amount to 0.4 of this load and whose side bearings have a spread of 50 in. is equal to 221 per cent of the normal reaction which is practically equivalent to the 220 per cent suggested by Prof. Endsley, and as it is our understanding that the side bearings on the hopper car used in the experiments conducted by Prof. Endsley were spaced 50 in. apart or the same as one of our assumed spacings, we have plotted the diagrams of Fig. 10, for a fibre stress of 16,000 lb. since the resulting values for the section moduli, for the bolsters having the same side bearing spacing, check with the formula shown in the upper

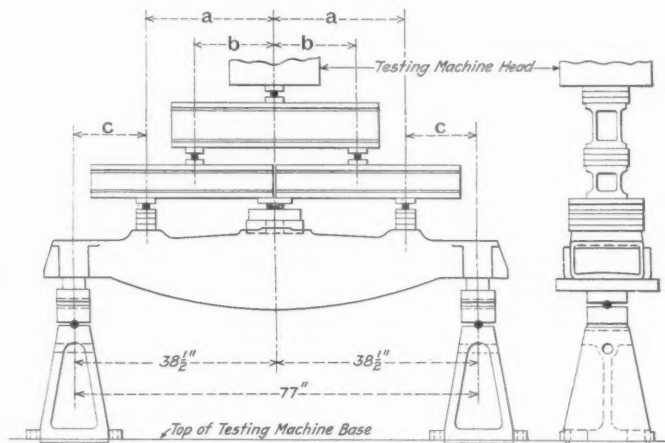


Fig. 13—Proposed Method of Testing Bolsters

part of the figure. Based upon a fibre stress of 16,000 lb. per sq. in., values for section moduli at the center of the bolster, as Fig. 5, are 110.5, 99.7 and 96.4, respectively, which of course, are slightly less than those for the 14,000 lb. fibre stress. At the side bearings for the 16,000 lb. stress, we obtain the values of 68.2, 40.4, and 30.4, as compared to 65.0, 44.2 and 34.8 by the formula method. The fact that these values approximate each other very closely at the side bearings, becomes more evident when the fibre stress is determined from the moments of Fig. 5 and the section moduli obtained from the formula, the stresses being 16,800, 14,650 and 14,000 respectively, for the 50-in., 60-in. and 64-in. spacing.

In purchasing truck bolsters, it is the practice of some railroad companies not to specify the method according to which the bolsters shall be designed but rather to require that the finished bolster shall undergo, in a satisfactory manner, certain tests commonly known as "design tests." Others require that the bolster be built according to a specified method of design as well as that the finished bolster meet certain specified tests, while others merely require that the bolsters be furnished in accordance with drawings submitted by the railroad company. Examples of the practice first mentioned are illustrated by the following sample specification.

#### DESIGN

"1.—On receipt of approved drawings for new designs the manufacturer will make a sufficient number of bolsters and truck sides for the purpose of making a design test. After the manufacturer has determined that samples are in accordance with drawings and that the design is satisfactory, he shall present not less than four additional samples for a final design test. The final design test is to be made upon a suitable testing machine at the manufactur-

ers' works in the presence of the railroad representative.

"2.—The samples used in the final design test will not be so distorted that they cannot be shipped on order.

"3.—After a new design is once tested as provided for in paragraph No. 1 and the design found satisfactory, no additional design tests will be required unless the design is subsequently changed, revised or modified.

"4.—The test loads herein specified are applicable only to a normal design of truck bolster and truck side.

"5.—A normal design of truck bolster will have the following general dimensions: For a 50-ton capacity car the width over bolster at guides not less than 13 in., depth at center not less than 14 in. and depth at ends not less than 6 in.

"The 50-ton truck bolster to stand the following preliminary vertical test load, 80,000 lb. with a deflection of

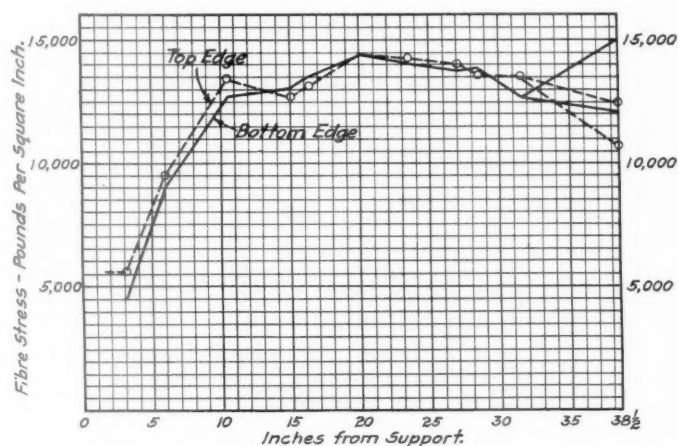


Fig. 14—Curves Showing Calculated Values of Bolster Stresses

not over 0.0625 in. For a 200,000 lb. load the deflection to be not over 0.20 in. and permanent set not to be over 0.0625 in.

"For the transverse strength the test loads to be one half of the vertical loads with the same deflection and set."

The above represents a type of specification quite generally followed in such instances and another specification reads as follows:

"For each 200 bolsters offered, two shall be selected at random, one to be used for vertical test and the other for transverse test of strength. If either test fails, the bolsters represented by them will be rejected."

Still another specification states that, "Bolsters will be selected at intervals, but not more than one in one hundred and one, for physical test to insure that the requirements are being fulfilled. The supports shall be 4 in. wide and the load shall be applied on the center plate in the vertical tests and in the transverse tests the bearing shall be 12 in. wide and in length equal to the depth of the bolster.

"Any bolster, or any lot of bolsters, may be rejected, which does not, or which do not, meet all the requirements of these specifications."

From the above, it is apparent that in the case of vertical tests it is customary to require the specified load to be applied at the center plate and the bolster supported at the center of the spring seats. Thus, while there is a tendency to call for a bolster having a greater relative strength near the ends, under a central load, or, in other words, to distribute the loading in such a manner as to increase the bending moment over what it would be in a case such as that covered by diagram 1, Fig. 1, the central method of loading is still generally adhered to. That method of loading, wherein one half of the load is assumed to act at the center bearings and one half at a side bearing is illustrated in Fig. 11, the left side bearing being considered in this

instance as has been the practice throughout this discussion. This method has been employed to some extent in strain gage testing, i. e., tests in which the actual elongation or contraction of the metal over a predetermined length of the member was measured by means of an instrument known as a strain gage in order to obtain the actual working fibre stress. If the bolster is loaded at the center plate and a series of strain gage readings taken and the load then applied as shown in Fig. 11, i. e., half the load concentrated at the center of the center plate and the other half at the side bearing, the stress corresponding to a system of loading represented by diagrams 5, 6 and 7 of Figs. 1 and 2, may be arrived at and compared with the calculated stress. This, however, is a laborious process and, moreover, furnishes no means of checking by actual tests, the strength (deflection and set) of a bolster designed in accordance with the systems of loading covered by Figs. 5, 7 and 8.

To bring out this point, the bending moment diagram shown at 9 in Fig. 5, has been selected and completed, the entire diagram being shown in Fig. 12. Now, if it be assumed that a bolster has been designed from this diagram, it would require a concentrated load of approximately 91,800 lb. at the center to create a fibre stress of 16,000 lb. per sq. in. at the upper and lower edges of a section at the center of the bolster. The resulting bending moment under this 91,800 lb. central load at each side bearing would be 619,918 inch pounds instead of 1,090,910 inch pounds, as was assumed in the design, some 43 per cent less.

The calculated section modulus would be equal to 1,090,910 divided by 16,000 or 68.2 which if it is assumed that the calculated and actual stresses check, would result in an actual stress of 9,090 lb. per sq. in. for this 91,800 lb. central load, i. e., the actual stress at the side bearing would be a little over half the calculated value and it would seem to indicate that the testing of bolsters by means of a system of central loading causes bolsters to take set principally at and near the center, whereas, the greater part of the failures in service, which many designers are now trying to overcome by increasing the strength of the bolsters near the ends, is not checked in testing and that testing by this method does not guarantee that the method of designing or that the bolster itself is all that it should be.

A proposed method of testing is suggested in Fig. 13 which we believe would be somewhat of an improvement over the method in which the load is applied at the center. While there may be one advantage of testing with a central vertical load, in that the deflection of the bolster under a static load or a load equal to the static load plus the amount due to oscillation is obtained, this is relatively a small amount, usually not over 0.04 in., or 0.05 in. and it would practically be a fixed amount for all normal bolsters of the same general design. In testing bolsters, it is certainly much more important to duplicate service conditions.

By the system of test loading shown in Fig. 13, a bolster designed from the moment diagram of Fig. 5 and the moduli diagram of Fig. 10, can be loaded in such a manner as to give a certain uniformly distributed fibre stress.

The curves for the calculated stress values of a bolster so designed are shown in Fig. 14, the values for the upper edge being plotted with broken lines and those for the bottom or lower edge with full lines. Two values for each edge are given at the center section as two methods are employed in determining the section moduli, i. e., the bolster center in the other. The bolster center plate ring was not considered in either case. The drop in the value of the fibre stress near the support is necessarily true of all well designed cast steel bolsters. Since depth at the columns is necessary to provide wearing surface, in addition to other considerations, such as thickness of metal, foundry requirements, and the influence on the design at other sections, most bolsters will exhibit a corresponding decrease in fibre stress near the

supports and thus slight differences in the bending moment curves for a distance of, say, 10 in. from the center of the support, are not of great importance, provided the bolster has good end depth.

Strain gage readings taken under this method of loading, should check the calculated stresses. Any appreciable difference could be attributed to the effect of any irregular or abrupt sections. This furnishes one of the principal reasons why design testing is necessary.

Since the method of loading suggested is at variance with the present practice, and is a radical change, it is the intention merely to suggest the method rather than any definite test loads. In case both the calculated and actual test requirements are specified, care should be exercised to see that the two are in harmony, otherwise the more rigid will determine the final design of the bolster and the less rigid might as well be omitted from the specifications. For illustration, let it be assumed that a bolster must meet the design specifications of Example 4 and the test requirements quoted above in which the deflection under a load of 200,000 pounds, must not exceed 0.20 in. and the permanent set not exceed 0.625 in. Now, three conditions must be met: first, the calculated fibre stress must not exceed 9,000 pounds per square inch; second, the deflection under a vertical test load of 200,000 lb. must not exceed 0.20 in.; and third, the permanent set must not exceed 0.625 in.; at this load. In this instance there are three vertical requirements which the bolster must meet in order to be accepted, but in case any one of the three becomes the limiting condition, then the other two requirements become valueless for that design. This may appear to be a rare occurrence, but unless great care is exercised, there is anything but harmony in the various requirements, as is evidenced by the increasing tendency to use one system of loading in design and another method in testing.

The preliminary vertical test load of 80,000 lb. with a deflection of not over 0.0625 in. would make a total of four vertical requirements, but as a deflection of 0.0625 in. for an 80,000 lb. load on a 50-ton design rarely occurs, we have not included the same in the above paragraph. The same is true of the preliminary vertical test loads for the 30 and 40-ton capacities, but not for the 70-ton. The allowable deflection for the preliminary vertical tests is the same for all capacities, i. e., 0.0625 in. The load for the 70-ton is usually taken as 130,000 lb. The axle for a 50-ton car is designed to carry a load of 38,000 lb., whereas the axle for the 70-ton car is designed for a 50,000 lb. load. The 80,000 lb. preliminary vertical test load for the 50-ton bolster is 2.1 times the load for which the axle is designed, while the 130,000-lb. test load for the 70-ton bolster is 2.6 times the axle load. Based on the axle load, it is evident that the test loads are more severe for the 70-ton than for the 50-ton bolsters. The loads for the 70-ton bolster should be 105,000 lb. and 263,000 lb., respectively, to be in proportion to the axle loads instead of 130,000 lb. and 300,000 lb. as seems to be the tendency in most specifications. In addition to specifying loads that are some 23.5 per cent and 14.0 per cent more than they would be if based on the corresponding axle loads, the depth of the bolsters for 70-ton cars is not, as a rule proportionately increased.

The required section moduli as determined by the two methods, i. e., by the formula of Fig. 3 and by the bending moment diagram of Fig. 12, assuming a fibre stress of 16,000 lb. per sq. in., are set forth in Table IV. At the side bearings which are located 13½ in. from the points of supports, the section moduli, according to the formula of Fig. 3, will be found to be 65.0 as against 68.2 by the proposed method. From a point 16⅔ in. from the points of supports to the center line, a larger section modulus is required by the formula, being 112.4 at the center of the bolster as against 110.5; or a difference of 1.9. The values obtained

by the two methods are in close agreement at the side bearings and at the center. The proposed method of loading and designing are suggested since this would give a means whereby the design could be checked by testing.

The following method may be used to determine the distance  $b$  of Fig. 13, which is the loading diagram suggested in connection with a moment diagram similar to the one shown in Fig. 12. By dividing the moment at either side bearing, by the distance from the side bearing to the point of support, shown as  $c$ , we obtain an amount, which, for convenience, will be termed the "new reaction." The quo-

TABLE IV—SECTION MODULI DETERMINED BY TWO METHODS

Distance from support	Calculated by formula of Fig. 3	Proposed method 16,000 lb. per sq. inch fiber stress
3¼ in. ....	18.2	16.4
6 in. ....	32.3	30.3
10½ in. ....	53.0	53.0
13½ in. ....	65.0	68.2
15 in. ....	70.5	70.7
16⅔ in. ....	75.3	73.0
20 in. ....	86.5	79.2
23½ in. ....	95.4	85.1
27 in. ....	102.4	91.0
28½ in. ....	104.8	93.6
31½ in. ....	108.7	98.6
38½ in. ....	112.4	110.5

tient obtained by dividing the bending moment at the center of the bolster by this new reaction, when subtracted from one-half of the length of the bolster, is equal to the distance  $b$  which locates the point of application of a load equal to one reaction. By way of illustration, an example may be worked out from the values given in Fig. 12, which are for the 50-in. side bearing spacing. In this instance the bending moment at either side bearing is equal to 1,090,910 in. lb. and by dividing this amount by the distance  $c$ , which is 13.5 in. for the case in question, the value of each reaction is found to be 80,808 lb. The quotient obtained by dividing 1,767,914 in. lb., the moment at the center of the bolster, by 80,808 lb., the value of the reaction just determined, is equal to 21.88 in. and represents the distance from the points of support to the points of application of the two equal loads, transmitted by the single beam immediately below the testing machine head.

The difference between 38.5 in. which is equal to one half the distance between the bolster supports, and 21.88, which is the distance  $b$ , is equal to 16.62 in. or approximately 16⅝ in. The difference between 21.88 in. and 13.5 in., which is the distance  $c$ , is equal to 8.38 in. or approximately 8⅜ in. This latter figure represents the distance  $a$  minus  $b$  shown in Fig. 13 and whichever one of the two values proved to be the most convenient to measure in loading the bolster, could be used.

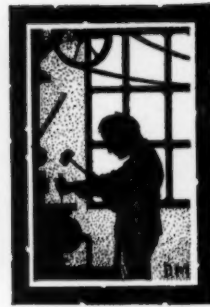
The distance  $b$  for the 60-in. side bearing spacing would be 17.59 in. and 17.92 in. for the 64-in. spacing. The total load on the former would be 152,660 lb. and 149,864 lb. for the latter, as compared to 161,616 lb. for the 50-in. spacing illustrated in Fig. 12.

The reaction at the end of the bolster support has purposely been termed the "new reaction" in order to distinguish it from the reaction used to form the diagram. Reference to the upper side bearing spacing of Fig. 4 will indicate that this new reaction is equal to the maximum reaction shown at the left of the diagram. Thus, the bolster under a test load of 161,616 pounds will be subjected to a stress at both ends corresponding to that which would have come upon the left end under the conditions shown in Figs. 4 or 5.

It has been the aim in the present article to outline the general principles involved in the design and testing of a truck bolster of a specific capacity, especially as to the method of loading, and as the suggested method of loading for design testing is entirely new, we have purposely avoided giving limiting deflection and set requirements.



# SHOP PRACTICE



## TERMINAL HANDLING OF LOCOMOTIVES\*

BY FRANK C. PICKARD

Master Mechanic, Delaware, Lackawanna & Western, Buffalo, N. Y.

Efficiency and conservation are especially necessary at this time in solving the transportation problem. We are engaged in the business of transporting necessities from where they are produced to where they are needed and the connection between these two places is a railroad, its motive power, vehicles for conveyance, tracks, etc. All must be kept in good condition. The locomotive must be kept as nearly one hundred

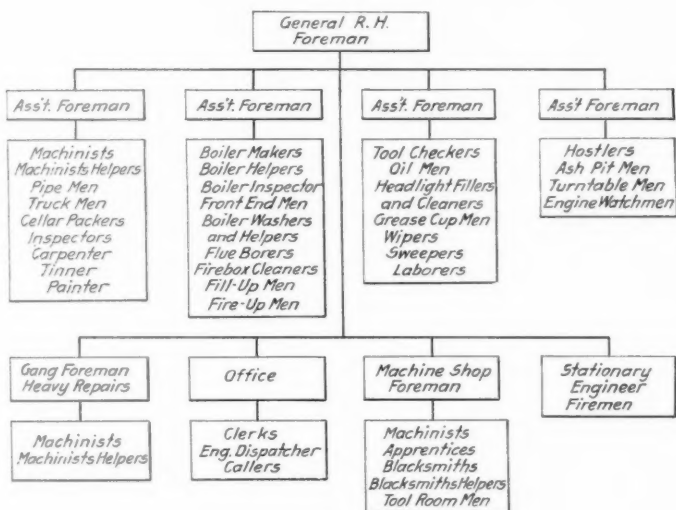


Fig. 1.

per cent efficient as possible and be detained at the terminal as little as possible, and to this end a few suggestions are offered.

When the locomotive arrives at the terminal, the first operation is the cleaning of the fire, or removing it entirely from the locomotive. For this purpose a suitable ash pit is necessary, and one of the best is the water type of pit, open on one side and containing sufficient water space to extinguish the hot cinders. This pit should be provided with a gantry crane and then one man can readily serve 125 locomotives every twenty-four hours, that is in handling the cinders. The labor for cleaning the fires can be handled to the best advantage on a piecework basis.

After the fire has been cleaned, the next operation is to thoroughly clean the machinery and running gear of the locomotive and tender, so that it can be properly inspected. By improved devices which are now on the market, the largest types of locomotives can be thoroughly cleaned in from seven to ten minutes by washing with a combination of fuel oil and water at about 90 degrees, aided by air pressure, which should be at 100 pounds to drive the best results.

An inspection pit, located next to the washing pit, should

\*Abstract of a paper presented before the Central Railway Club.

be long enough to take in the entire locomotive and tender and be equipped with sufficient lighting facilities to enable the inspector to do his work thoroughly. For greater convenience it is desirable that entrance to this pit should be from the outside through a suitable subway.

From the inspection pit the locomotive goes to the engine house, and here the most important factor is the organization. For a terminal caring for approximately 100 locomotives per 24 hours, Fig. 1 shows an organization which is recommended. The organization represented in Fig. 2 may be used when it is desired to specialize between the different classes of power.

In regard to the engine house equipment, about the most important single item is a first class turntable of ample length and sufficiently strong in design, so that it will not spring under the heaviest load. The alinement of tracks across the table is important. Every mechanical man appreciates the layout of tracks, so that in handling locomotives in and out of the house or moving them back and forth for valve setting no time is lost in shifting the table. In climates where considerable snow falls a double drive is desirable, that is, a motor on each end of the table coupled in multiple.

An engine house is not complete unless equipped with sufficient tools to handle properly and promptly any work likely to come in, and the larger terminals should be supplied with

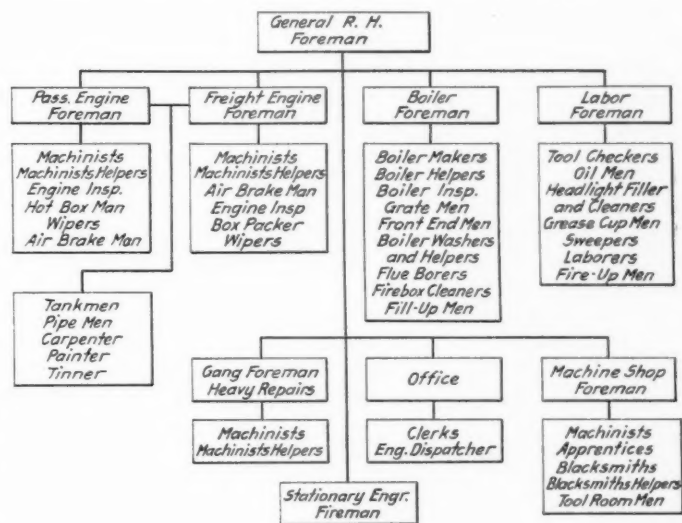


Fig. 2.

cylinder and valve chamber boring bars, a valve facing machine, a crank pin truing machine and portable tool boxes and benches.

A well defined plan of handling the work is needed and no time should be lost from the moment the engineman's report comes in until it is sub-divided among the different foremen and finally done and checked off on the work slips. It is desirable on a division with a large number of locomotives to have a special man assigned as general inspector to cover the entire locomotive and to see that all requirements of the

federal and government laws are complied with. No roundhouse is complete unless it is equipped with a hot water washout plant of sufficient capacity to take care of all the washouts. This does away with the breakages that are due to expansion and contraction caused by the quick change of the temperature of a locomotive boiler when it is undergoing the washing process. It also tends to save fuel and time in getting an engine up to the required steam pressure.

Suitable drop pits with jacks large enough to readily handle the heaviest wheels are needed and these pits should have adequate drainage and lighting facilities.

No other appliances are of more assistance to the prompt despatching of power than electric and acetylene welding outfits. They are time savers and labor savers.

For handling the coal there are many varieties of docks of the gravity and mechanical type, the former being recommended. The coal dock should be located so that it will cover the locomotives as they approach the enginehouse, this being desirable on account of delays in coaling when the engines are being despatched. It is also desirable to have suitable water cranes located on tracks leading to and from an enginehouse. With these properly placed, no time is lost in moving engines back and forth to give them water, when required. One is desirable for the switch engine movement and another for the road and passenger engines.

A suitable report should be made of terminal delays to the mechanical officers in charge so that they can tell just what time a locomotive arrives and when it is again made ready to depart. This will enable them to make a study of the delays and eliminate possible bad practices.

Of course, there is no doubt that improvements are needed at almost every terminal, but they are harder to obtain now than at any previous time, so we must take the present facilities and do the best we possibly can. Speed up, eliminate lost motion and attend to the little things that go to bring about prompt despatching and furnish the locomotives that the country needs.

#### DISCUSSION

As a stimulus to the discussion of the subject, the author added to the paper a list of twelve questions, which worked out very nicely, as it gave the members something definite to talk about. The majority of those who spoke favored cleaning locomotive fires on a piecework basis rather than on a day wage. Some roads pay 35 cents per engine for this work. The washing of engines, as described by the author in his paper, was considered very good practice but it was deemed inadvisable to use this system when the temperature got below 10 above zero, as it was difficult to keep the water from freezing on the locomotive. The majority of the members favored the use of outside inspection pits. Mr. McIlvaine, superintendent motive power of the Northern division of the Pennsylvania, stated that the use of inspection pits was practically universal on the Pennsylvania lines. Most of the members thought that two motors would hardly be necessary on their turntables, but that a motor of sufficient capacity should be provided to operate them under very poor conditions.

The majority of the members found that more supervision was necessary under present labor conditions. None of those who spoke found it necessary to use women in enginehouse work except as clerks. A vote taken on the question as to whether each locomotive engineman should have an individual tool box or whether a set of tools should be assigned and kept on the locomotive, showed that the latter system was much to be preferred. Most of the members stated that the locomotives were coaled on going into the roundhouse. The plan of organization shown in Fig. 1 was preferred. Everyone favored having a tool room in connection with the enginehouse and some of the members advocated passing the tools out on check.

The price for cleaning fires on the Lackawanna is 35 cents per engine for locomotives having 55 sq. ft. of grate surface and less, and 45 cents per engine for locomotives having a grate surface larger than that. Thirty-nine cents is paid for washing engines.

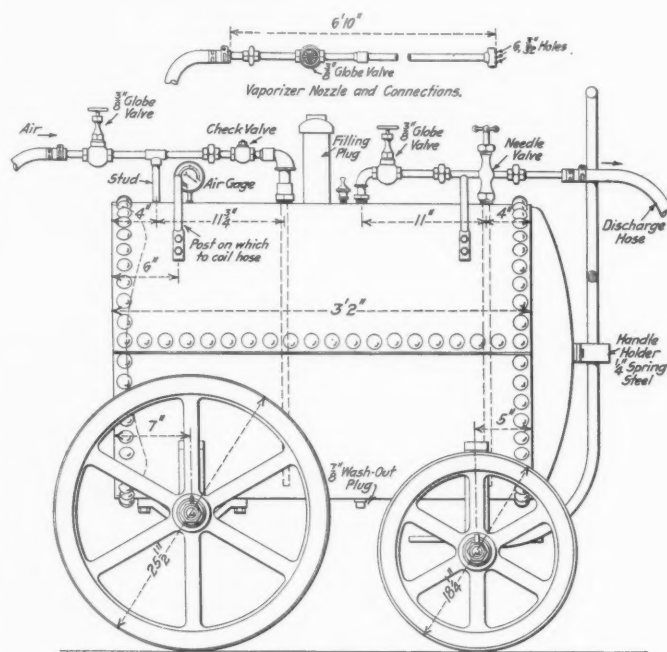
### LOCOMOTIVE FIRE KINDLER

BY E. A. M.

The locomotive fire kindler illustrated is a valuable device to have in a roundhouse and it aids materially in reducing locomotive time at terminals. Boilers are washed and blown out periodically at about 28 day intervals and for this purpose it is, of course, necessary that the fire be knocked out of the engines. To calk flues and do several other repair jobs the fire must be taken out and also when engines are tied up for repairs for a day or more, it is obviously poor economy to keep the fires.

In order to reduce the time of locomotives at terminal points, some arrangement is necessary to kindle the fires quickly, and the device shown has proved valuable for that purpose.

In operation, all old waste and car shop scrap wood is saved; the coal is placed around the edges of the firebox and the waste and wood in the center. The fire kindler



Locomotive Fire Kindler

is then used for spraying the oil around, enabling the fire to get a rapid and complete start. A suitable blower connection applied to the smokestack will then insure the rapid spread of the fire and a very quick attainment of full boiler steam pressure.

The fire kindler consists of a 27-in. by 38-in. reservoir, supported and bolted by means of braces to 2-in. square axles, the ends of which are turned down to 1 1/2 in. for wheels and the extreme ends being threaded and drilled for a 1-in. nuts and taper pins. The front brace has a disk at the bottom, resting on the axle and this provides for greater ease in turning. The device is easily moved from place to place as it is needed. The air hose is connected to the shop air line, the supply of air being controlled by the 3/8-in. globe valve shown. A glance at the piping arrangement on top of the fire kindler will show that the air passes through this globe valve, then through a check valve and down to the tank. On the other side there is an air and

oil outlet, the oil pipe extending nearly to the bottom of the tank. There is a filling plug where the fuel oil is poured in and the bottom of the tank is tapped for a  $\frac{7}{8}$ -in. plug for use in washing out. Four posts are provided, two on each side, for coiling the air hose on one side and the discharge hose on the other. There is also an air gage for registering the tank pressure, and a spring clip to keep the handle up out of the way such as would be the case if it were allowed to rest on the floor.

The discharge hose is connected on the outer end to a

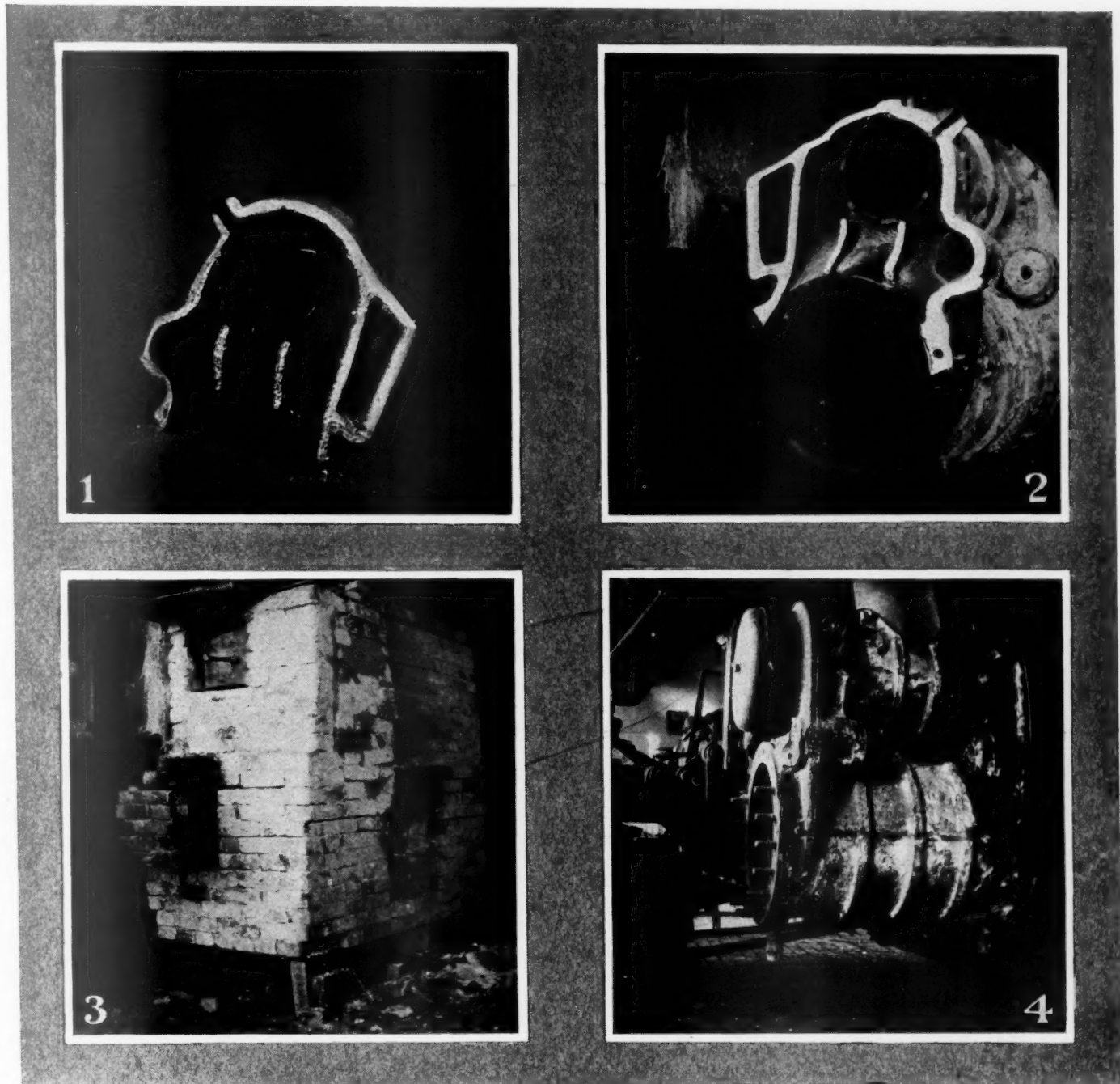
## A DIFFICULT CYLINDER WELD

BY D. A. DONALDSON

Apprentice Instructor, Baltimore & Ohio

The importance and value of an oxy-acetylene welding equipment to a railroad shop or roundhouse terminal is well known and is still further demonstrated by the successful repair of the serious cylinder break shown in the accompanying illustration.

During the cold spell of last winter one of the B. & O.



B. & O. Engine Cylinder Successfully Welded by Acetylene Process

vaporizer nozzle which is shown in the upper part of the illustration.

By adjusting the various valves it is possible to obtain just the right proportion of air and fuel oil through the nozzle, which is placed in the firebox door. The device is inexpensive to make and has given good results in actual service at enginehouse terminals.

locomotive cylinders froze while waiting at the cinder pit. The piece shown in Fig. 1 was broken off from the left cylinder and valve chamber as a result of water being confined in the valve chamber and freezing. The peculiar position of the break made a weld seem impossible, but nevertheless it was attempted. The results exceeded the highest expectations and a total saving of more than two-

thirds the cost of a new cylinder was effected. It is almost impossible to figure the saving due to putting this locomotive back into service in less than a week, as was done. Had a new cylinder been applied at this terminal, the engine would have been in the shop at least a month.

The broken surfaces of the cylinder and the piece which was broken off were chipped in the usual way, as shown in Figs. 1 and 2. Owing to the location of the break, a piece had to be cut out in order to allow welding the inner wall. This is shown in Fig. 1 by the series of holes in the right side. After this picture was taken another break was found and welded.

An iron ring was turned and drilled to fit over the studs and served as a clamp to hold the piece in place on the cylinder. After it was bolted up, a furnace of firebrick was built entirely around the cylinder, as shown in Fig. 3. Openings about 12 in. square were left in the brick wall for firing. Sheet-iron lids were provided to fit the openings as shown. The fuel used was coke and charcoal. In this manner the cylinder was kept at nearly a red heat during the entire welding operation, which eliminated the possibility of expansion cracks, such as are usual in welding large castings. The cylinder was heated and then such bricks as covered the break were removed and welding started. Three men worked one day on the job, two alternately handling the torch, while the third kept the cylinder at a uniform temperature. The usual flux was used with the filling metal. After the weld was completed, the furnace and clamp were removed and the part covered by the clamp on the joint, was built up.

A light cut with the facing machine finished the job. The cylinder is now as good as a new one and the engine is still out making mileage. Very little stripping was necessary, the cylinder and valve chamber heads and lagging only being removed. The piston was left in the cylinder and was not injured.

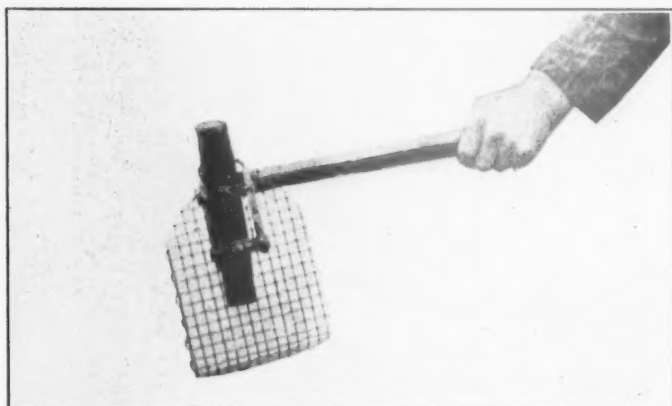
As stated before, the successful weld of this cylinder break only goes to show the necessity and value of a welding equipment at locomotive repair shops and round houses. There is almost no limit to the amount and variety of work that can be done by an experienced welder.

## HANDLE CHISEL GUARD

BY HENRY SPERL

Tool Foreman, Erie Railroad, Susquehanna, Pa.

The chisel guard shown in the illustration is in use at the Susquehanna shops of the Erie, and has been found effective in preventing rivets and bolt heads from flying about when they are being cut. It is made of wire netting,



Handle Chisel Guard

cut to the shape shown and riveted to a piece of  $\frac{1}{4}$ -in. wire bent in the form of a loop. This loop fits over the head of the chisel and is reversible, so that the chisel may be used either right or left.

While the use of such a safety device will result in some little inconvenience to the workman, any care taken to avoid accidents is well worth while. There is no comparison between the inconvenience resulting from the use of a safety device and the inconvenience to a man who has received injury.

## LOCOMOTIVE SIDE PLAY

The maintaining of side play or lateral motion on driving wheels is recognized by railroad officers as one of the important items of locomotive maintenance. Broken driving boxes, broken rods, and other costly engine failures are often directly traceable to excessive lateral motion and many locomotives are held at roundhouses waiting for one or more pairs of wheels to be dropped to take up side play.

Many different methods of applying hub liners to wheel centers and repairing the hub faces of driving boxes are in use, each method as a rule, having some good points in its favor. Such items as material costs, length of time to apply and facilities for applying should not be used altogether as a basis on which a selection is finally made; rather the length of service ought to be the deciding feature. The original cost or the convenience of initial application is insignificant when compared with the damage that may be brought about by poorly designed or poorly applied hub liners. When power is scarce, the loss of a locomotive held out of service for one or two days to have side play taken up is a serious matter and costs the company much more than it would to apply the hub liners properly in the first place.

As a comparison to bring out and develop the best method of maintaining lateral motion, the four methods most commonly used will be described. Owing to such a wide range of labor conditions it is impossible to furnish accurate comparative costs, but each method as described will be explained in detail so that the reader can easily form an opinion as to which is the best from an economical and a service standpoint.

**Boiler Plate Hub Liner; Babbitt on the Box.**—This method consists of applying a boiler plate hub liner to the wheel center by spot welding, after which the wheel is put in a lathe and the hub faced smooth. The hub face of the driving box is built up with babbitt.

Applying the boiler plate liner to the wheel center gives a very hard surface bearing and by spot welding and also welding at the edges there is small liability of the liner coming off. No machining of the liner is required, as it is simply punched out as near to shape as possible and laid in the recess cut in the wheel center. As it is welded around the edges it is immaterial how rough the edges are prior to welding. This method of preparing the wheel is excellent as it gives a lasting job at small cost, and the distance between wheel hubs is maintained constant.

The driving box hub face is prepared by pouring babbitt in a dove-tailed groove and facing it off to the required thickness on a boring mill. The only objection to the use of babbitt on the driving box is that a locomotive with a long rigid wheel base exerts a heavy pressure on the hub faces in rounding curves. The metal is far too soft to withstand this pressure and soon wears out if it is not melted out by the high temperature due to the friction. Brass on the hub face of the box would give much longer service.

**Brass Hub Liner; Boiler Plate on the Box.**—In this case the wheel hub is prepared by applying a brass liner in two halves, using countersunk head bolts through the wheel center with the nuts outside. The wheel hubs are drilled from a standard template and the brass liners are machined and drilled to this same template so that in taking up the side play it is only necessary to remove the old liners and apply new ones of the required thickness.

The time saving feature of this practice is that the hub

liner can be changed without unwheeling the engine. The process consists of dropping the pedestal binders and driving box cellars and backing out the liner bolts as the heads are brought successively under the journals. Two bolts can be removed in one position and then it will be necessary to move the engine to get the other two. With this kind of hub liner there is a considerable saving over the time and effort required in unwheeling an engine, as is necessary with most of the other kinds.

In actual practice this arrangement of hub liners is giving good service on one of the smaller eastern roads whose standard practice is to apply a boiler plate side bearing to the driving box by spot welding. The advantages of welding a boiler plate liner on the driving box are the greater strength of the box, increased bearing surface, longer life, lower cost and less material planed off from shoe and wedge faces because these faces are not warped out of parallel as would be the case where a box is heated by pouring on babbitt or brass liners.

As the brass hub liner is softer than the boiler plate on the box it takes practically all the wear, and thus whenever the lateral play becomes excessive it can be taken up in less than a day's time at any roundhouse. It is usually good practice to head over the bolts on the outside of the nuts and thus insure the hub liners against working loose.

*Cast Iron Hub Liner; Brass on the Box.*—Some roads still adhere to the practice of using cast iron hub liners in spite of the many objections to it. The use of cast iron on the wheel hub is not recommended because it breaks or crumbles so easily, even when new, and when half worn out has practically no strength to resist the constant pounding to which it is subjected. The cast iron liners are applied by countersunk head set screws or by simply drilling straight holes and driving in a neat fitting cast iron plug. This latter method has a tendency to break or crack the hub liner and does not give good service. This method is economical for initial application, but, based on the length of service, it is one of the most costly.

The same criticism of the use of brass or babbitt in the driving box hub faces applies to this method as to those previously described. Brass driving box side bearings give more or less unreliable service because many shops using scrap brass do not get a uniform mixture and often burn it. When this happens the liners are liable to break and fall off, or crumble under the heavy pressure. Furthermore, too great dependence is placed on the contraction to hold the liner on the box face, and in case of a hot box it is liable to come loose and either fall off or be pounded off.

*Cast Brass Hub Liner; Babbitt on the Box.*—In using cast brass hub liners the wheel center recess is prepared for the liner by screwing in several countersunk head set screws and then pouring on the brass. As the metal cools and contracts, it cracks in one or more places, but due to the countersunk head set screws it will not come off. After both wheels have been poured, it is necessary to put the wheels in a lathe and face the hubs to the required thickness. This is an expensive practice and the preparations also take longer than those previously described. Handling the wheels to pour the brass on the hubs is expensive and many shops are not equipped for this work. The driving box hub faces are prepared by building up with babbitt. It is very doubtful if the length of service obtained from hub liners of this type warrants the cost of application.

While it has been suggested in all cases to use a boiler plate liner, it is not necessary, however, to limit the material particularly to boiler plate, for a liner forged in the blacksmith shop out of a scrap car axle will give equally as good service.

It is possible to use a steel liner on both the box and the wheel hub. The idea that two medium hard steel surfaces will not run face to face and give good service is not borne

out in practice, for it is a fact that several roads are now using this method for maintaining the side play on their locomotives. In this case the only question is that of lubrication and with so many hard grease cellars in use it is possible to drill an oil hole from the recess in the top of the driving box diagonally to the side bearing, thus securing proper lubrication without the need of providing detachable oil cups.

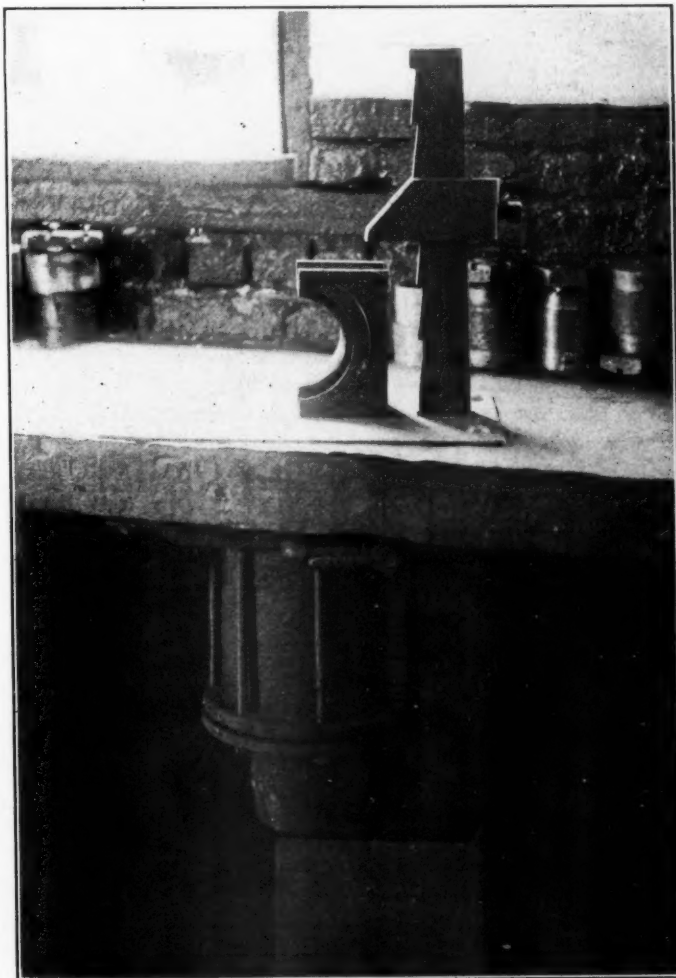
In conclusion it may be stated that the second method gives the best results of the four methods described, but a bearing of steel against steel offers attractive possibilities if proper attention is given to lubrication.

## PNEUMATIC BENCH CLAMP

BY G. C. CHRISTY

Master Mechanic, Yazoo & Mississippi Valley, Vicksburg, Miss.

The time and effort required to lift one main rod brass from the bench and clamp it in a vise may be comparatively small, but if enough brasses have to be handled and it is possible to save a little time on each one, the total resultant saving will probably be surprising. Such at least, has been the experience of the Yazoo & Mississippi Valley at Vicks-



A Convenient Bench Clamp.

burg, Miss., in the use of the pneumatic bench clamp illustrated.

The machine consists of a brake cylinder bolted to the under side of the bench with its push rod pointed down and direct connected to the lower end of a  $\frac{3}{4}$ -in. by 3-in. vertical iron bar which moves up and down through a guide in the bench. The sheet iron casing below the brake cylinder is a



pressure acting with a thrust of 10,214 lb. to overcome the peak resistance of 9,478 lb. in the low pressure air cylinder, so that the stroke is readily completed and the reversal takes place.

In the case of the standard compressor, the "floating piston" is so little advanced at the end of the stroke that the full thrust of 10,214 lb. only occurs at the very end of the stroke and has no opportunity to speed up the stroke of the first stage side.

In the altered compressor with the "floating piston" distinctly advanced at the end of the stroke over the first stage side, the relief of the back steam pressure takes place much sooner, and the large steam thrust of 10,214 lb. acts through all the latter part of the stroke; this speeds up the first stage side of the compressor, which results in a greater number of strokes per minute, therefore giving the compressor more capacity.

In operation this compressor will develop a higher temperature in the air cylinders on account of its increased speed. The higher intermediate air pressure will tend to heat up the low pressure air cylinder more than in the case of the standard pump. Nevertheless the high pressure air cylinder will be subject to the higher temperature and this with less cylinder wall to radiate the heat will require that special attention be paid to the lubrication of the cylinder.

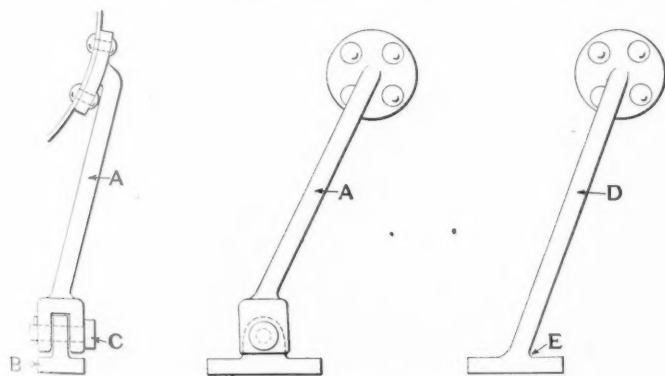
The figures presented in this article are based on 180 lb. steam pressure and a main reservoir pressure of 140 lb. This shows that the altered compressor is well suited for passenger service where these pressures prevail. The standard compressor working under these conditions would work far too slowly to handle the required amount of air promptly, at times when the demands for air were high. The arrangement of air compressor described above has been tried out on the Grand Trunk and given satisfaction; its use is being extended.

### FRONT DECK BRACE

BY JOSEPH SMITH  
Baltimore & Ohio, Lorain, Ohio

To overcome the frequent delays due to the breaking of front deck braces on switch engines the brace marked *A* and shown in the illustration was devised by J. Wilson, blacksmith foreman, Lorain shops.

A front deck brace marked *D* had been in common use and on one engine in particular a good deal of trouble was



An Improved Front Deck Brace

experienced and it was necessary to shop the engine frequently on account of the foot of the brace breaking off at point *E*.

To overcome the difficulty a brace similar to *A* was applied to this locomotive two years ago and has given no trouble since. The jaw of the brace is of the general dimensions shown and is connected to the bracket *B* by a  $1\frac{3}{8}$ -in. steel pin *C*.

It is hoped that the accompanying illustration may offer a helpful suggestion to others who are having difficulty with broken front deck braces.

### BALL BEARING CRANK PIN

BY B. P. FLORY

Superintendent Motive Power, New York, Ontario & Western, Middletown, N.Y.

The accompanying illustrations show the application of a steel ball bearing to the front crank pin of the 2-10-2 locomotives used on the New York, Ontario & Western. When these engines were first received they had a brass ball bearing

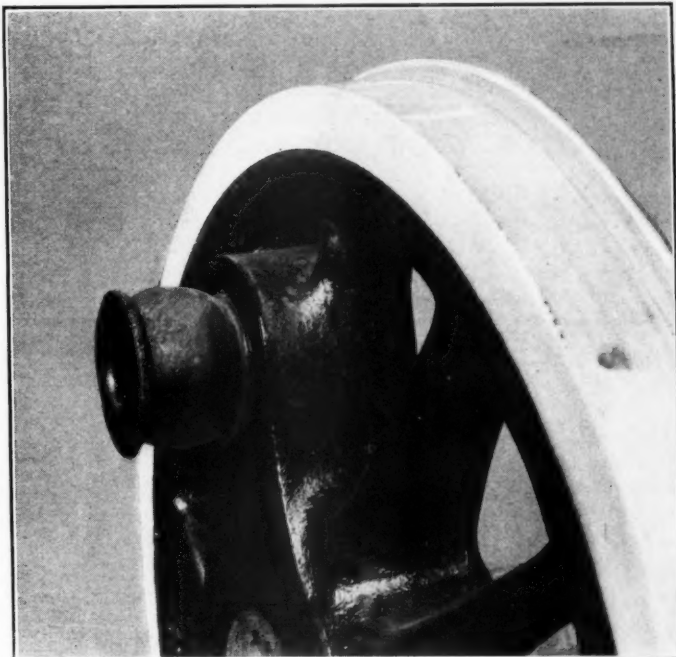


Fig. 1—Ball Bearing Front Crank Pin, 2-10-2 Class

which would crush out on the side and break off the collar on the crank pin, allowing the rod to come off.

To obviate this difficulty, the arrangement shown in Fig. 1 was devised by William Pohlman, general foreman at the

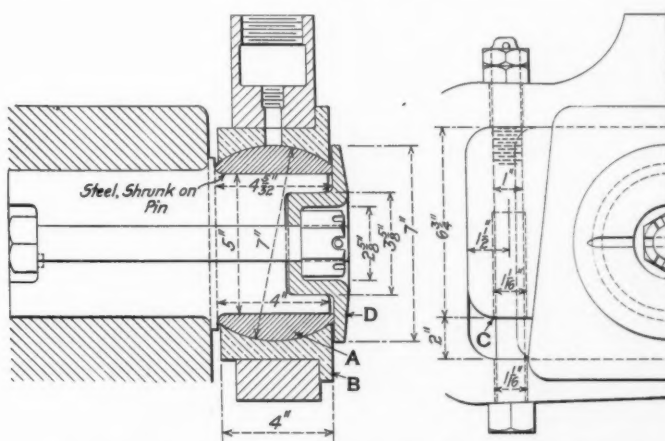


Fig. 2—Detail of Ball Bearing Crank Pin and Rod Brass

N. Y., O. & W. shops, Middletown, N. Y., and it is giving very satisfactory service.

Referring to Fig. 2, a steel ball bearing *A* is shrunk on the original crank pin. The brass bushing *B* is made in two sections, being held together by the wedge *C* and making a running fit on the ball bearing crank pin. In case of ex-

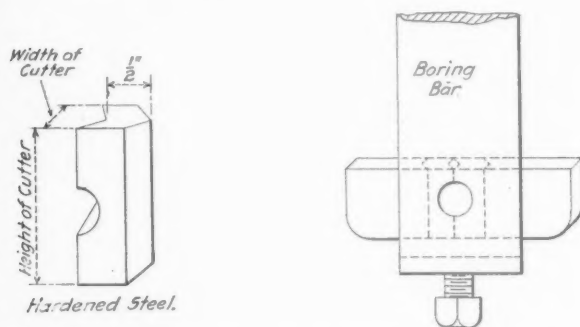
cessive wear, the rod would be held on the crank pin by the collar *D* as is customary.

The advantage of this form of front side rod connection is in the reduction of strain on the rod when the locomotive is rounding a curve. It is especially valuable and, in fact, necessary, on a locomotive with a long rigid wheel base.

## PROLONGING THE LIFE OF CUTTERS IN DAVIS BORING BARS

BY CHARLES TRIMBY

At the Kansas City shops of the Missouri Pacific a method has been devised for increasing the life of cutters used in the Davis boring bars for boring out car wheels. The way in which this is done is clearly shown in the sketch.



Inserts Double the Life of Boring Bar Cutters

Two pieces of steel are shaped to fit between the cutter, increasing the space between them one inch. This doubles the life of the cutters and effects a considerable saving, especially with the present price of high speed steel.

## CUTTING TOOL LUBRICATION

BY R. B. HUYETT, M. E.

Progress in the cutting of metals and in the lubrication of cutting tools, can be divided into three periods of evolution. The first period is often referred to as the good old days of the backyard shop when the boss and his workmen vied with each other in the performance of difficult work requiring great skill, owing to the lack of proper equipment. Each shop was limited in the quality and quantity of its product by the skill of the individual workman. During this period, the time necessary to complete a piece of work was a secondary consideration. The workman was expected to use his skill in performing the work as nearly perfect as possible, regardless of the time consumed in so doing. The machine tools then employed, while they accomplished wonders in comparison with hand work, were not equipped to perform the greatest amount of work in the shortest time. Lubrication of cutting tools was unheard of and unnecessary. The machines were not as yet built to run at high speeds.

The second period of evolution dawned with the introduction of the semi-automatic and automatic machines and quantity production. Up to this time, the capacity of the machine had been limited by its own strength and speed, or rather by the absence of both, and not by the quality of the cutting tools. The introduction of quantity production necessitated the design and construction of machine tools of greater strength and speed. Then it was found that the cutting tools (all low carbon) would not stand up under the speed of which the new machines were capable, as the friction at these speeds generated enough heat to soften the tools and make them lose their cutting edge.

To remedy this, experiments were made along the line of reducing the friction of cutting. Friction was reduced in

bearings by lubrication, why not here? So a squirt of oil now and then was tried on the theory that some might get between the tool and the work and grease the cutting edges. The futility of trying to eliminate or reduce this friction soon became apparent, as nothing could be gotten between the cutting edges of the tool and the work. It was found that a little lubricant at the rake of the tool where the chip slides back over it might do some good, but only a very little. At this time, for some unaccountable reason, it did not occur to the experimenters that, although they could not prevent the great friction at the cutting point and in this way prevent heat, they could arrange to dissipate it as fast as it was generated and, in this way, prevent the tool from becoming the conductor and burning. Instead of developing a means of taking the heat away from the tool they developed a tool steel which, as they thought at the time, could withstand the heat. This was then called high speed steel, and was similar to that in use today.

In the third and present period machine tools are designed with much greater cross-sectional area, larger and longer bearing surfaces, special alloy steel parts and greater driving power. These improvements make them capable of such high speed as to generate sufficient heat to destroy the cutting edge of even the high speed steel tools which had been thought immune from heat.

Up to this time, the manufacturers of high speed steel tools claimed that their tools should not be used in connection with coolant. It was discovered, however, by users of the tools, that when a  $\frac{1}{4}$ -in. or  $\frac{3}{8}$ -in. stream was circulated over the tool, there was a very marked lengthening of its life. Working, perhaps on the theory that if this small amount of coolant was good, more would be better, many progressive engineers tried the use of more.

Among these experimenters was F. W. Taylor, who arranged to circulate without pressure, a large stream of coolant instead of the small  $\frac{1}{4}$ -in. and  $\frac{3}{8}$ -in. streams. The results were remarkable. As much as a 40 per cent increase in cutting speed was found possible with less deterioration to the tool and a far smaller number of tool grinds. To quote from Taylor's book on *The Art of Cutting Metal*: "In cutting steel, the better the quality of tool steel the greater the percentage of gain through the use of a heavy stream of water. The gain for the different types of tools in cutting is:

a	Modern high-speed tools.....	40 per cent
b	Old style heavy-hardening tools.....	33 per cent
c	Tempered tools .....	25 per cent

Such a statement as this started investigation in the right direction and the possibilities for increased efficiency by scientific cooling of the cutting tool are gradually being more and more recognized. However, there still exists a deplorable amount of indifference to these possibilities even in many otherwise progressive shops, as is evidenced by the smoking tools and hot chips. It will pay any executive interested in increased profits to investigate these conditions. The absence of smoking tools or hot chips is not always conclusive evidence that enough coolant is being used because the machines may be slowed down.

What is the difference between a lubricant and a coolant? A careful analysis of the subject, based on actual tests, has shown that the principal function of a stream of liquid over the cutting tool is to carry away the heat generated by the friction of cutting metal with metal. While there is a slight lubrication at the rake of the tool where the chips slide off, the real function of the liquid is to carry away the heat from the tool and prevent its temper from being destroyed. Lubrication therefore is a misnomer and the word "coolant" is a much more appropriate term. To quote from Becker's work on high speed steel: "While the word lubrication is in common use in this connection, it really is a misnomer to speak of lubrication in connection with metal cutting. It is quite impossible to force oil or other substances between

the tool and the chip. The purpose of the so-called lubricants in the main is merely to assist in carrying away heat from the place where the work is being done, thus keeping down the temperature of the cutting edge and lip of the tool below the point where softening will begin."

#### VOLUME OF COOLANT NECESSARY

The size of the stream of coolant to be used depends on the speed of the machine, the depth of the cut, and the kind of material. The easiest and only sure way of knowing when enough coolant is being used is to run the machine at its maximum speed from the standpoint of the strength of machine, material and tool. If the tool smokes or the chips come off hot at this speed, an insufficient amount of coolant is being used and the flow should be increased. It is far better to use too much than too little coolant and Becker puts it this way:

"The small streams customarily used are quite ineffective. It is necessary to deliver gallons of coolant where it has been customary to deliver pints. The heavy streams serve another useful purpose in cases where the chips come off small or well broken up in that they carry or float them out of the way."

Since to cool is the prime function of the liquid, it naturally follows that the best liquid to use is that which possesses the greatest cooling qualities. The lighter and therefore more easily evaporated the liquid, the greater its cooling qualities. Consequently, water fills the necessary requirements when properly mixed with a sufficient quantity of some good cutting compound to eliminate the corrosive effects of water alone. Such water solutions are not only much better coolants than pure oils, but are far cheaper. Oils pick up heat slowly and release it more slowly while water picks up heat quickly and releases it more quickly.

It is not sufficient that a copious flow of coolant be used for a great deal depends on the manner of application. It must be directed at the right point and delivered at a slow velocity.

According to Taylor, "a series of experiments has demonstrated that water thrown directly upon the chip at the point where it is being removed from the forging by the tool will give higher allowable cutting speeds than if used in any other way." Further along he says: "After deciding to try experiments upon the cooling effect of water when used upon a tool, it was our judgment that if a stream of water were thrown upward between the clearance flank of the tool and the forging itself, in this way the water would reach almost to the cutting edge of the tool at the part where it most requires cooling, and that, by this means the maximum cooling effect of the water would be realized. We therefore arranged for a strong water jet to be thrown between the clearance flank of the tool and the flank of the forging and made a series of experiments to determine the cooling effect of water with various feeds and depths of cut. So confident were we of the truth of this theory that we did not deem it worth while to experiment with throwing streams of water in any other way until months afterward, when, upon throwing a stream of water upon the chip directly at the point where it is being removed from the forging by the tool, we found a material increase in the cutting speed, and thus our first experiments were rendered valueless.

"Practically great difficulty will be found in getting machinists in the average shop to direct the stream of water on the chip in the proper way as indicated, because when a sufficiently heavy stream of water is thrown upon the work at this point it splashes much more than when thrown upon the forging just above the chip; and a machinist prefers slower cutting speeds and less splash. The most satisfactory results are obtained from a stream of water falling at rather slow velocity, but with large volume."

#### MEANS OF DELIVERING COOLANT

Machine tool builders have often overlooked the necessity of supplying adequate coolant circulating facilities on their machines and in order to overcome this defect some users have gone to considerable expense and trouble to install a gravity system to provide the proper flow and eliminate the troubles of the gear-type pump, such as loss of prime, clogging, short life, etc. The installation of a gravity system costs several times per machine what it would to provide each machine with an efficient individual pump at the present time. By installing gravity systems, users of machine tools have done nothing more than trade the troubles incident to the use of the old gear-type pump for those of the gravity system. With a gravity system in use, it is necessary that all machines connected with the system use the same grade of coolant. It is unsanitary, requires constant attention and, if the least thing goes wrong, every machine connected with the system is put out of commission until the defect can be repaired.

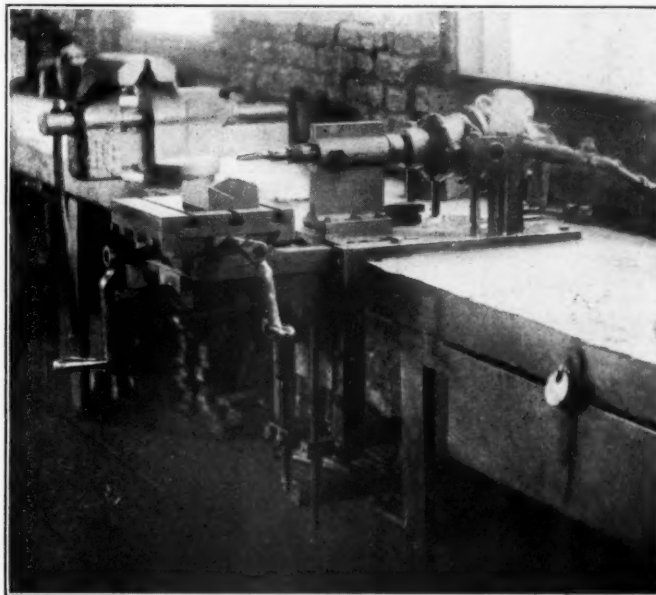
Many machine tools are still being furnished to the users with small capacity pumps and small sized piping. This necessitates the changing of the circulating system on machines by the users. Although it seems uneconomical it is far better to throw away the small capacity pump and piping than to use it. A few dollars spent to get a pump and piping of the right capacity will be saved many times over by the increase in production and the lowered tool expense.

### BENCH DRILL

BY G. C. CHRISTY

Master Mechanic, Yazoo & Mississippi Valley, Vicksburg, Miss.

The bench drill illustrated was devised and tried out at the Vicksburg, Miss., shops of the Yazoo & Mississippi Valley and has given good satisfaction in actual practice. It consists of an air motor, socket and twist drill substantially supported on the bench and bolted to a framework which carries an adjustable table. This table has movement in



Air Motor and Bench Drill

three directions, so it is a simple matter to center any work requiring drilling.

The machine is especially adaptable to such work as drilling holes in rod bushings, cotter key holes in wrist and knuckle pins, etc., but its principal advantage lies in the fact that small drilling jobs do not need to be taken to the

drill press, but may be done at the bench as needed. This will save many steps and much time previously spent in waiting for work at drill presses which are usually overcrowded. In large shops there is most always more drilling to do than can be quickly handled and the installation of some such home-made machine as the above bench drill would help relieve the situation.

## INDISCRIMINATE USE OF THE INJECTOR CAUSES BOILERS TO LEAK\*

BY GEORGE AUSTIN

General Inspector Boilers, Atchison, Topeka & Santa Fe

Working the injector too much while the engine is standing, is the secondary cause of many firebox leaks and failures, on account of causing extreme variations of temperature between the upper and lower parts, due to injecting a large quantity of water at one operation. Heavy clinkered fires, short firing, or other causes which tend to cause poor steaming, operate to produce unequal temperatures. Poor injector work is also a close second in causing corrugating and cracking of firebox plates, and especially so when aided by bad water conditions. The only excuse for reviewing the injector subject, is that personal observation, on our own road shows these matters are not as well understood by some of those in direct charge of the locomotive as they should be, or if understood, their importance is not fully appreciated. Many enginemen are good boiler men. They rarely make a boiler failure, and then only when it is unavoidable. Others are good at everything else, but, if there is a chance to cause a leak in the firebox of their engine, they are pretty certain to make use of it, either through ignorance or indifference or both. Some of our enginemen get from a fourth to one-half greater mileage from a set of flues of the same type of locomotive in the same service than others, the principal reason for which will be found to be better injector work.

John Purcell, assistant to the vice-president of the Santa Fe, has prepared a book on the care of locomotive boilers and their appurtenances, one of the rules in which reads as follows:

"Engine crews and hostlers should be instructed to use the injector as little as possible when the engine is standing. Boilers should have at least two-thirds of a glass of water when set out for service. Incoming engines should have nearly a full glass of water before the crew leaves them, and the water should be put in while the engine is moving from the train to the ash pit. Use of the injector, while the engine is standing, should be avoided whenever possible to do so. It must be understood, however, that safety of the boiler is the first consideration, but that can be had by using the injector frequently for short periods. Instead of injecting large quantities of water into the boiler at one operation, a good safe rule to follow is not to put in more than one-half an inch of water at any one time while the engine is standing."

The above rule is as good a rule as the book contains, and our men who understand and live up to it are good men with the boiler, as well as with the rest of the machine. They know that when they start an injector, there is a stream of water about 200 degrees colder than the boiler, entering it at a rate of from 40 to 100 gallons per minute, and that this colder and heavier water sinks to the lower parts of the boiler shell and firebox water spaces filling up those parts, and if continued, cooling and shortening all parts in proportion to the reduction of temperature. To illustrate how much the cooler portion shortens, a flue 20 feet in length will change its length one-sixty-fourth of an inch for each 14 deg. change in temperature. Therefore, if

only 112 deg. difference in temperature is produced between the upper and lower parts of a boiler, the bottom of the boiler is  $\frac{1}{8}$  in. shorter than the top. So are the lower flues, which are in this cooler strata, and it becomes a tug of war with the odds in favor of the hot ones, because there are more of them; therefore, the bottom flues leak most frequently. If a 20-foot flue will change its length one-sixty-fourth of an inch for every change of 14 deg. in temperature, a 10-foot side sheet will change its length one-sixty-fourth of an inch for each change of 28 deg. and you can believe there is much more than 112 deg. difference. A difference of 200 deg. is not uncommon, and we have a record of 244 deg. or more than  $\frac{1}{8}$  in. difference in length between the upper and lower parts of a firebox side sheet. The cooler part must contract and the process causes the hotter and longer part to buckle out slightly between the staybolt rows and assume a slightly wavy form, the staybolt being in the trough, or lowest part between the waves. This bulging or wave forming crimps the end of the bolt on the fire side of the plate and opens slightly on the water side and breaks the joint. This starts the staybolt leak, which most frequently shows when engines have stood a few minutes at the ash pit after the engine crew has injected the water which should have been put in before they left the train, or while coming from the train to the ash pit, or it is caused by the hostler using the injector before, or after engines are placed in the roundhouse. In short, the engine crew did not handle the water according to the best practice for the good of the boiler and the conditions prevented the hostler from doing so.

One or two shocks with the injector does not always start flues leaking, but if the flues are near the leaky point, it will usually start them leaking, and any one who will do it once unnecessarily, does it through ignorance or indifference, and will do it any time the injector is started. There are times when it may seem impractical to do the best thing for the boiler, but there are so many times it is just as easy to do it as not, that the engineman who adopts the system becomes a good man with the boiler and when he once acquires the habit he will hold to it.

Flue and staybolt leakage is frequently attributed to cold air entering the firebox, but when one considers the relative density of air and water, there seems slight probability that cold air can have any appreciable effect in causing firebox leaks. Consider for example, that the fire, when the engine is working, reaches a temperature of 2,600 deg., and the water in the boiler at 225 lb. pressure gets to 396 deg. and yet the high temperature of the fire, as shown by tests does not heat the plates above 450 deg. if they are clean. This is because the greater density of the water gives it the power to absorb heat as fast as the flames can give it to the plates. Therefore, cold air will have as little effect to cool plates when backed by hot water as the flame has to heat them when backed by water, but cold air entering the firebox does affect the steaming. We trade water for steam while the engine is working, and trade a tight firebox or flues, or both, for leaky ones, while drifting down hill or standing at stations.

The use of the blower on the modern large boiler has little effect to promote circulation. It is true that it will maintain the steam pressure, but the cold water goes to the bottom just the same, and using the blower maintains the top temperatures while the bottom temperatures continue falling as long as the injector is operated.

A clean fire gives the best circulation, and no particular harm results to firebox sheets, but with a heavily clinkered fire, or an oil burning engine with considerable of the area of the lower parts of the firebox sheets covered with brick, there is a very serious doubt whether the use of the blower while using the injector is not altogether the wrong thing to do, for the reason that there is no circulation below the

\*From a paper presented before the Western Railway Club.

fireline. The hotter water circulates on the top of the cold water in the water leg of a locomotive firebox just the same as if the mud ring was raised that much, there is no circulation unless there is heat to produce it. When there are 8 to 12 inches of clinkers in a coal burning engine, there is no circulation, when the engine is standing, below the top of the clinker. In an oil burning firebox there is no circulation back of the brick work, which covers the heating surface of the firebox plates, until the bricks become hot enough to produce it, and it seems very likely that condition is responsible for some of the corrugating and cracking of firebox sheets, and leaking flues and staybolts in oil burning engines.

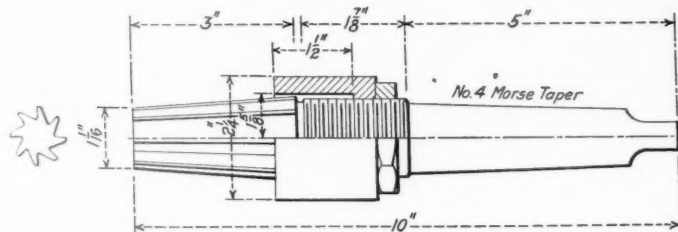
There are no doubt many who are somewhat skeptical of the importance of operating the injector only when the engine is working, that is, if it can just as well be avoided. There is not a student or investigator of the subject, but will agree to the truth of what has been said here. It is too often the case that flue failures are classed as unavoidable and passed without investigation, or the cause is attributed to poor care in the roundhouse, which is very unfair to the boiler men, unfair to the company and equally so to the man who was responsible, because of permitting him to become careless in his handling of the locomotive and acquiring habits which depreciate his work. By encouraging our engineers and hostlers, not to use the injector when the engine is not working unless it is absolutely necessary to do so, and favor the boiler all possible we will get a better performance of boilers and engines and less frequent and extensive repairs will be required.

In connection with the subject of injector and blow off cock use, it must be apparent that railroad companies should require their firemen to obtain a reasonable knowledge of the effects of producing unequal temperatures before promoting them to take charge of an engine. Hostlers also, should be required to know how to properly care for the locomotive while in their charge: Do not put it all up to the boilermaker, let the other fellow do his part.

## REAMING TAPERED HOLES TO STANDARD SIZES

It is often desirable to ream tapered holes to a standard size, as for instance on the piston rod fit in air compressor piston heads. Where an ordinary reamer is used there is certain to be considerable variation in the sizes of the holes, unless the taper is very small. To overcome this difficulty the type of reamer shown below has developed in the Bloomington shops of the Chicago & Alton.

The body of the reamer has a threaded portion between

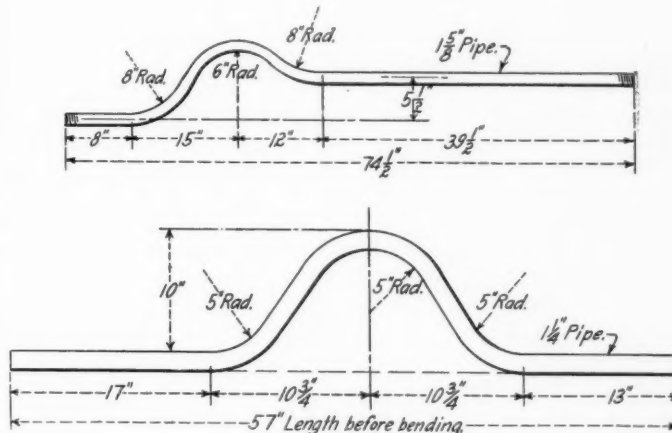


A Reamer Which is Handy for Duplicating Tapered Holes

the flutes and the shank. Fitting over the threaded portion of the body is a stop, which is movable but can be held at any desired point by a lock nut. The stop is adjusted so that it comes in contact with the work when the hole has been reamed to the proper dimensions. Any number of holes can be reamed without the least variation in the size. When it becomes necessary to sharpen the reamer, the stop can be removed. By means of a plug gage or caliper, the original setting can readily be duplicated.

## HOME MADE PIPE BENDER

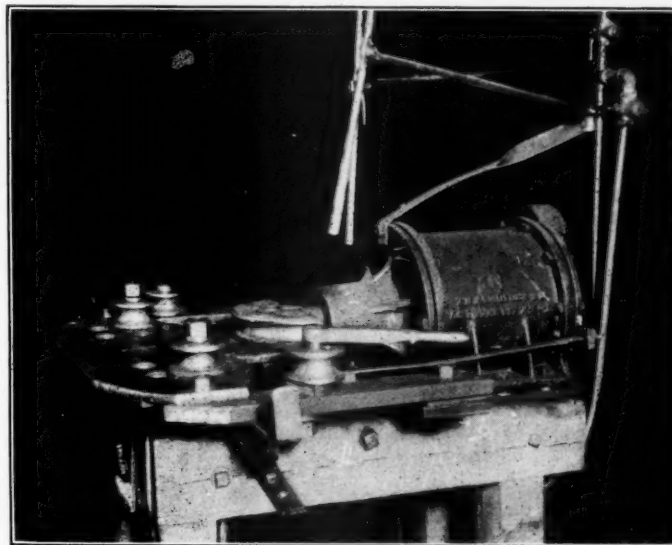
A pneumatic pipe bender with several novel features is in use in the car department of the Danville shops of the Chicago & Eastern Illinois. The device, which is shown in the illustration, bends pipes to any angle desired without heating and without the use of springs or sand to prevent kinks. Three bends can be made at one time on certain classes of



Parts Formed in One Operation on Pneumatic Pipe Bender

work, as for instance in forming the offset in the train line to pass over the Cardwell draft gear spring.

The device consists of a 14-in. air cylinder, the piston of which extends out over a heavy iron plate. The piston is arranged to carry grooved dies of various sizes and the plates carry three grooved rollers, set on studs, which can be shifted to various positions. At one side of the plate is a movable arm which carries a fourth roller mounted on an



A Pipe Bender Designed for Car Work

eccentric. This can be brought into position by a short handle and is spaced so that when a straight piece of pipe is placed between the two sets of rollers, the eccentric will hold it firmly in place. A movable stop is provided, in line with the roller, so that in making duplicate parts the bends can be located in the proper place. The table is marked to indicate the angle of the bend, which can also be judged by the travel of the piston.

In making single bends only two of the rollers are used. To form offsets as in the train line pipes shown below, the pipe is held by the four rolls and the offset is formed in a single operation. Having the bends all made with the pipe

horizontal has been found a great advantage in working with long pipes. This bender is adapted for a large variety of work and has been found to be well suited for producing parts in quantities as well as for general repair jobs.

## "DON'TS" FOR APPRENTICES AND OTHERS

BY HENRY GARDNER

Don't "monkey" with a machine "just for fun," as a machine will not take a joke, and you will be punished every time.

Don't try to operate a machine for the first time without receiving full instructions from some one in authority.

Don't shift heavy belts by hand unless you are an expert, and then great care should be taken not to get caught.

Don't wear shoes that are so worn out that a splinter or nail will go up through the sole and cause a serious injury.

Don't wear ragged, loose sleeves when running machines, as the ends are likely to be caught somewhere, and you will lose a finger or two.

Don't chip toward any one without a screen between you.

Don't stop a planer by half shifting the reversing belt; always stop it by the countershaft.

Don't lean against a machine that is running, and it is better to keep a safe distance from any mechanism in motion or likely to be set in motion. Never ride a planer table.

Don't use the emery wheel without wearing the goggles provided by the company.

Don't touch the teeth of a moving gear or cutter.

Don't set a lathe or planer tool when the work is in motion.

Do not allow a tool to run by the work so far as to cut into a lathe spindle. A machine looks strong, but it can be very quickly and easily injured.

Don't score a planer bed or make holes in a drill table.

Don't lay a long file or any tool on the ways of a lathe; don't cut into a lathe arbor.

The running part of a machine should be oiled every day, and sometimes oftener. If you take a machine that some one else has just been running, don't trust that it has been oiled that day; oil it yourself, but stop it first.

Don't waste oil by pouring it on so that the greater part runs away; the company loses a great deal of money through the careless use of oil; a drop in the right place does more good than a cupful on the floor.

Don't be afraid of soiling your hands, as it is impossible to work in a railroad shop and keep your hands white and smooth. Don't wear gloves except for the roughest work and never when running machines.

Don't get your suit of overalls covered with grease and dirt; with a little care you can keep much cleaner than you think. A dirty suit doesn't always mean that you have done a lot of hard work; it more often indicates a careless, untidy disposition.

Don't put your tools where you can't find them easily; "have a place for everything and everything in its place."

Don't let files destroy one another by throwing them together in the drawer. Don't use a monkey wrench for a hammer.

Don't put finished work in a vise without using copper or lead jaws.

Don't swing a sledge or hammer that you know is working loose on the handle, thinking that it won't come off 'til next time; you may not get hurt, but what about the other fellow?

Don't strike highly tempered steel with a hammer; many eyes are destroyed from this cause alone.

Don't do a bad job; any man to whom a bad job is not a lasting mortification shows himself lacking in self-respect. A long job may soon be forgotten, a bad one never.

Don't go over your foreman's head with your grievances,

as the man you go to will send you back to the foreman and give you no satisfaction; moreover, the foreman will never forget it.

Don't have a grouch. Be cheerful and willing at all times. Smile once in a while.

Don't borrow tools and forget to return them; it is best not to borrow tools at all.

Don't forget that you are an inexperienced young man, learning a trade, and that every one in the shop can teach you something, and there is an easy way to get this knowledge; simply be respectful and they will help you.

Don't forget that although you are drawing wages, you are costing the company some money for the training they are giving you. You have spoiled work and thrown it in the scrap pile, and you may have broken valuable tools, and possibly you have injured some expensive machine.

Don't get excited and cross over little things. Many a man has lost splendid opportunities by letting his temper run away with him.

Don't spend your entire life in the shop and don't talk too much shop outside of working hours. All your leisure time (except that spent in study) should be given up to rest and wholesome recreation.

Don't worry about your work; if you have made a mistake and spoiled a piece of work, don't be afraid of what the boss will say; take what he has to say and don't do it again.

Don't think that you are so important that the company can't get along without you; there is always some one waiting to take your place and do your work as well or perhaps better than you did.

Don't be afraid to work a few minutes overtime without pay; no matter what the foolish ones say, you will make an impression on the boss, which may put you ahead of them all some day.

Don't spend your money foolishly. Save a little if you can. Start a bank account, if only a very small one.

Don't be too thin-skinned and touchy; many a competent young man has taken off his overalls and quit because he couldn't stand the jokes of the shop men or some hasty order or censure given him by a busy foreman.

Finally, don't forget that there is always room at the top. Keep striving for that goal, as no one knows just when he will arrive there. Keep plugging away every day doing your best, and time will tell. If you are not kept in the service after serving your time, there is generally a good reason, and nine times out of ten you will guess the reason without any one telling you.

## LUBRICATING OIL DENSITY\*

BY W. F. SCHAPHORST

The importance of the specific gravity or density of oil as a measure of its lubricating properties is much overestimated because no evidence is given of the actual constituents. On the other hand, the specific gravity test is of considerable value in identifying oils. For example, if a certain oil is giving satisfaction its density may be determined and compared with that of any oil claiming to be the same, thus giving a check on the claim. Density or specific gravity of a liquid is usually measured by means of an hydrometer, and one of the arbitrary scales used with the hydrometer is the Beaumé scale. As lubricating oil is used by many people who do not understand the Beaumé scale and the hydrometer, it is the purpose of this article to give a brief illustration of their use and also a simple method of determining specific gravity, in case the hydrometer is not available.

When the statement is made that an oil has a specific gravity of  $X$  deg. Beaumé, it is simply necessary to add  $X$  to 130 and divide the sum into 140, which gives the density. This

\*Copyright by W. F. Schaphorst.

result is obtained by use of the following formula, as taken from Kent:

Sp. Gr. (light liquids) =  $140 \div (130 + \text{deg. Beaumé})$ .

To find how this formula works out in a particular case, consider the following problem: What is the density of a 31 deg. Beaumé oil? Specific gravity =  $140 \div (130 + 31) = 140 \div 161 = .87$ . It is evident that an oil whose density is 10 deg. Beaumé is just as heavy as water, because  $140 \div (130 + 10) = 1$ .

In case no hydrometer is available for the determination of the specific gravity, the following method may be used, and the only apparatus necessary is a clean jug and an accurate weighing instrument: Let

A = the weight of a clean empty jug.

B = its weight when filled with water.

C = its weight when filled with oil.

The specific gravity can then be determined by the use of this simple formula:

$$\text{Specific gravity} = \frac{C - A}{B - A}$$

This amounts to dividing the weight of a certain volume of oil by the weight of the same volume of water, which accords with the definition of specific gravity. The temperature of the water, oil and jug should all be the same throughout the test, and if possible maintained at 60 deg. F., which is the standard.

### SIDE ROD STRAPS

For a shop equipped with an acetylene welding outfit, the Lehigh & Hudson practice in making side rod straps, at Warwick, N. Y., is of interest, especially in case the blacksmith shop is overcrowded with work, or is not equipped with a power hammer sufficiently heavy to forge the straps.

The method involved consists in laying out two straps

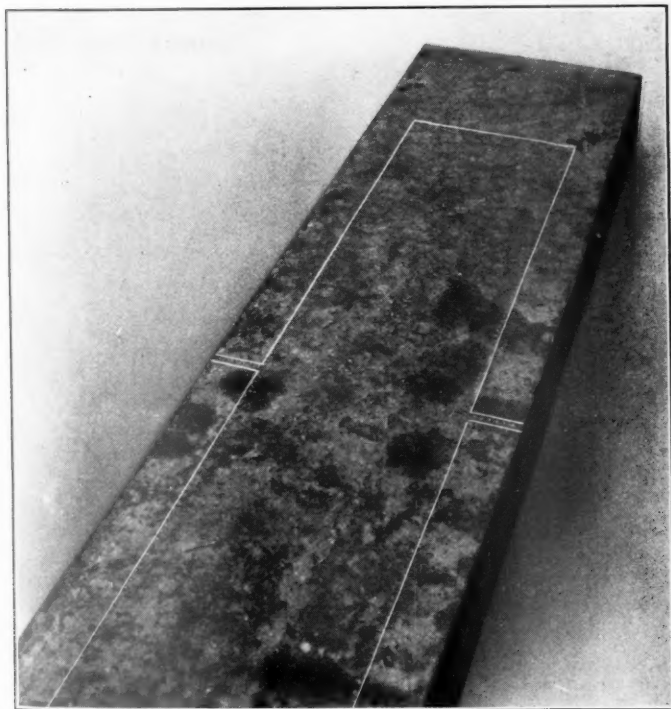


Fig. 1—Straps Ready to be Cut Out with the Torch

on a bar of hammered steel of the correct width and thickness, as shown in Fig. 1. The legs of the straps are laid out toward each other, so that they may be cut out with the acetylene torch, leaving the center in one piece to be later forged into a drawbar. Enough stock is left on the straps

so that they may be machined on the slotter, as shown in Fig. 2. It is believed that a rod strap cut out in this way with the acetylene torch is equal to, if not better than a forged strap, and is just as easy to machine.

If the prints call for a solid grease cup on the strap, a threaded bushing is applied by electric welding, which gives a quick and satisfactory job. In fact, this is the best way to apply a grease cup even in the case of a forged strap, there being a considerable saving over the old way of forging a lump of steel on the strap, to be later machined to make the cup.

In regard to the relative cost of a forged strap and one which has been cut out with the acetylene torch, it is believed

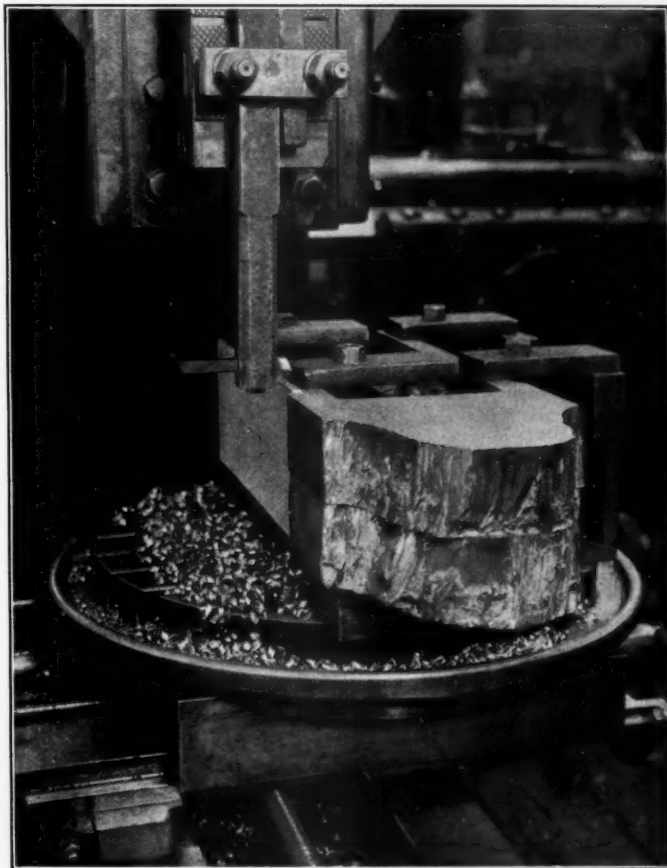


Fig. 2—Straps are Machined in Pairs on a Slotter

that the latter method will result in a material saving. In the case of the middle connection side rod strap illustrated, the cost of material and cutting complete was \$30.35 per strap, which would be reduced considerably if it had not been necessary to buy the original bar of hammered steel from the manufacturer on account of insufficient hammer equipment to forge it in the local shop. The price, \$30.35, does not include the cost of machining, but when it is considered that the builders charge \$160 for a new strap, the total saving will be evident. It has proved economical to cut out the straps and make them in this way, even at the high cost of hammered steel purchased, and the saving would be relatively greater in the case of a shop equipped to draw out their own steel billets.

**BRITISH CAR REPAIR PROBLEMS.**—Considerable delay has occurred in the repair of British freight cars, and there is a serious congestion. The Railway Executive Committee appealed to the car repairing companies to take steps to deal with the difficult position. Recognizing the necessity for immediate action, it has been decided to form a new company, which will take over the freight car repairing business.



# NEW DEVICES

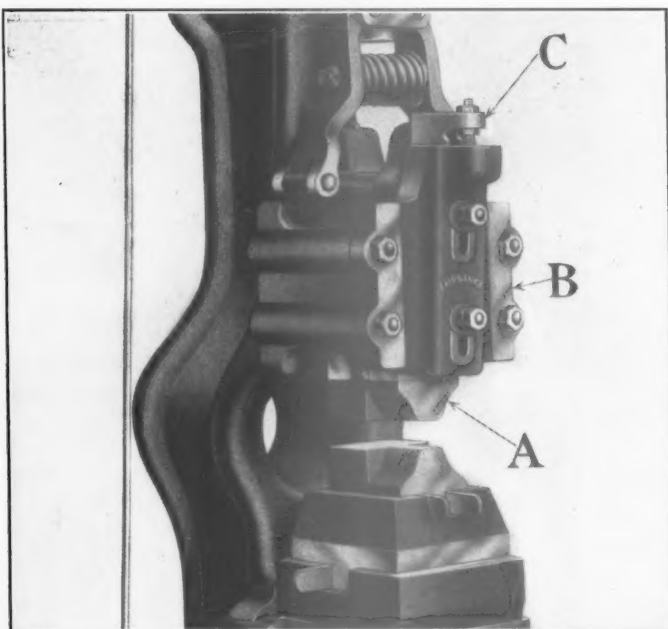


## POWER HAMMER ATTACHMENT

The new taper gib and face plate attachment illustrated is used on the Fairbanks power hammer manufactured by the United Hammer Company, Oliver Building, Boston, Mass., and the object of the attachment is to provide a quick and effective means of taking up slack as the hammer becomes worn in service.

Different kinds of dies are furnished, depending on the kind of work it is desired to do and the lower die is fastened to the base of the hammer by a tongue and groove arrangement and a suitable taper key. The upper die shown in the illustration and marked *A* is fastened by the same means to the ram.

The ram is held in place by the face plate *B* and the taper gib *C*. It is provided with two opposite vertical ribs, one of which fits in a groove in the body of the hammer and the other in a groove in the taper gib. The motion of the ram up and down is controlled by these two ribs as they slide in their respective grooves. As is usual in the



Power Hammer Attachment for Taking Up Wear

case of the smaller power hammers the operation is controlled by a foot pedal.

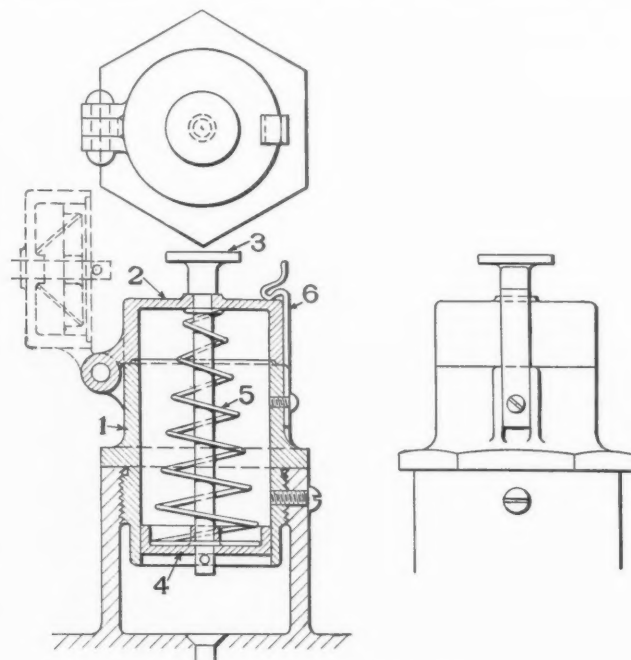
It will be noted that two studs project through the center of the face plate *B*, the other ends being made into the taper gib. When, on account of excessive wear, it becomes necessary to take up the slack in the ram, the nuts on these two studs are loosened and the taper gib forced down by means of the adjusting screw shown at the top. When the slack has been all taken up the nuts on the two studs are

again tightened, which holds the gib firmly in position.

By the use of a taper gib and a face plate attachment as described, it is possible to maintain just the right amount of play between the ram and its guides and this assures better work and a longer life for the hammer.

## ROD LUBRICATION

The lubrication of the heavy side rods and main rods of locomotives is a problem of considerable importance in railroad service. Not only is it important from the standpoint of hot bearings, but the lubrication must be as nearly perfect as possible to reduce the wearing of rod brasses to a minimum,



Automatic Hard Grease Cup

and thus keep the slop out of the rods due to loose bearings on the crank pins.

While some roads still use oil cups for lubricating the rods, most of them have adopted a grease cup. The cup commonly used consists of a bushing which fits into the lug on the rod, on a line with the bearing. Through this bushing a malleable iron plug is screwed which forces down the grease into the bearing, the plug being turned down by the use of a wrench. This is not only a tedious method, but also a rather indefinite one, and it requires a man to be continually using a wrench in order to keep the rods properly lubricated.

Another bad feature of the screw plugs is the fact that they become loose, due to the jars and centrifugal force exerted in the rods, thousands of plugs being lost during a year of service on a single road.

The grease cup illustrated works automatically, the only requirement being that it shall be kept filled with grease. It can be applied readily to rods which have been equipped with a screw plug, as the threaded portion is of the same size as the cap for the screw plug.

The cup consists of a body 1 which screws into the rod, a hinged cover 2, through which a plunger 4 and telltale 3 is passed, and is forced down on the grease by spring 5.

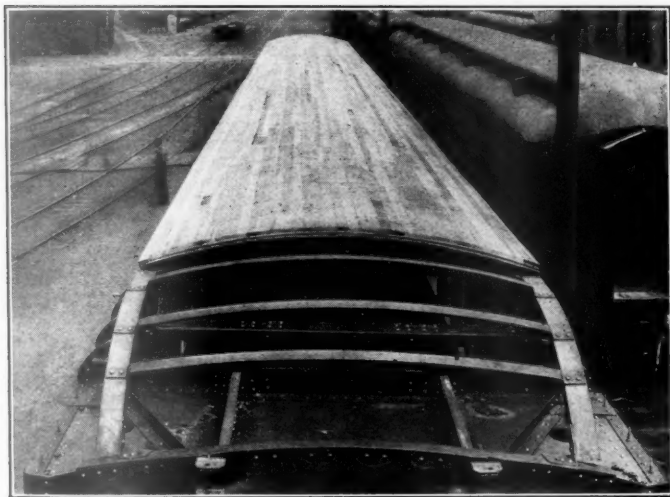
The main advantages of this form of a grease cup are that it works automatically and the handle at the top tells the engineer at a glance just how much grease is left in the cup. As a safety measure, the plunger is not allowed to go all the way to the bottom of the cup, a cavity being left which holds a small amount of grease to fall back on in case the cup is not filled immediately, thus preventing a hot bearing. Another advantage is that it is entirely enclosed, so that no grit or dirt can become mixed with the grease, which would tend to wear the bearings. All parts are securely riveted so that they cannot become lost or removed without cause. The cap is held down securely by means of the spring clip No. 6.

When the cup is to be filled, the plunger is pulled up within the cover by means of handle 3, and held while grease is being applied. When the cover is closed the plunger is automatically released, and the pressure transferred to the grease. The spring is of such a tension as to give the required pressure for feeding grease to the bearing.

This grease cup was designed and patented by G. E. Baldwin, mechanical engineer for the Bell Locomotive Works, located at Lincoln, N. J.

### TREATED CANVAS ROOFING FOR STEEL PASSENGER CARS

Considerable difficulty has been experienced in the maintenance of the roofs on steel passenger equipment where steel has been used throughout in the construction. Owing to the action of cinders along the top of the cars there is great difficulty in keeping the steel properly covered with a protective coat of paint. As soon as the paint covering becomes broken or cracked, deterioration of the steel plates begins



Type of Passenger Car Roof Construction Using Wood Sheathing and Treated Canvas Covering

and proceeds rapidly, especially where the joints in the roof plates project above the smooth surface of the roof, due to the formation of sulphuric acid from the action of water on the cinders. It is also a fact that no matter how stiff the construction of a car may be, there is always more or less weaving of the roof, which is evidenced by the condition of the joints in the sheets after they have been in service for some time.

A special type of canvas roofing, the material of which is impregnated with a treatment making it both waterproof and proof against mildew, has been furnished for several years past by the Tuco Products Corporation, 30 Church street, New York, and much of this material is now in use on wood passenger equipment. In the application of this material the use of white lead is unnecessary, thereby effecting a saving of labor and material. Otherwise the same practice is followed as with any other canvas roofing, the special advantage being that should the protecting film of paint become cracked, thereby permitting moisture to come directly in contact with the material, it does not deteriorate from mildew as is the case with untreated canvas. Within the past few years a number of railways have adopted a semi-wood roof construction in order to secure the advantages of this type of roof covering, which has demonstrated its advantages through many years of service on wooden equipment.

A type of wood roof construction for steel equipment is shown in the illustration. The tongued and grooved wood sheathing is applied directly to furring strips bolted to the steel carlines and projecting slightly above their upper surfaces. Intermediate wood carlines are placed between the steel carlines to provide additional nailing strips for the sheathing. The Tuco Standard car roofing is then applied to the sheathing in the usual manner. This construction provides its own insulation, a considerable saving in itself, and also eliminates the troubles with the joints of the metal roof, due to the weaving action and the rapid deterioration of the projecting surfaces, caused by the impinging action of the cinders and corrosion. There are now a large number of steel passenger cars on which this or a similar type of roof construction and Tuco Standard roofing has been used.

The treated canvas roofing when properly applied and well sanded is fireproof, and serves all the purposes of the steel roof. In addition its life is much greater than that of the steel. Cars with roofs covered with this material are now in service with the roofs in good condition after ten years' service. The material is furnished in three weights, designated as "CC," "AA" and "FF," which correspond to No. 4, No. 6 and No. 8 duck, respectively.

### HORIZONTAL BENCH MILLER

The machine illustrated, known as the No. 1 horizontal bench miller, is made by the Bickett Machine & Manufacturing Company, Cincinnati, Ohio. It is especially designed with a view to economical production and the highest possible quality and quantity of output. It is a handy, all-around jobbing machine and, as is often necessary in railway tool rooms, will do both light and fairly heavy work to good advantage. It is well adapted for such operations as end milling, keyseating, oil grooving, face milling, splining, "T" slotting, gear cutting and straddle milling. Many similar operations can be performed on this machine with greater speed and precision than on the average milling machine.

The machine is arranged for both power and hand feed and may be mounted on a bench or a pedestal. With the power feed on, the movement is transmitted through a series of worms and worm gears that gives it the steadiness and strength of a screw feed. The low cost of the machine and the small amount of floor space and motive power required make it a convenient addition to any tool room.

The different parts of the Bickett miller are designed and made with especial care, the spindle being of crucible steel, accurately ground and mounted on Gurney ball bearings. It is provided with a means of compensation for wear. This spindle has six possible speeds and will safely run at 2,500 r. p. m. continuous operation.

The arbor is made of tool steel accurately ground all

over and is fitted with a set of cast iron spacing collars  $1\frac{1}{2}$  in. in diameter and an arbor support bearing bushing. Both arbor and collars are keyseated. The arbor support arm is made of solid steel,  $1\frac{15}{16}$  in. in diameter, turned and ground all over and is provided with a solid cast iron arbor support bracket. This bracket is fitted with a bushed center bearing and also a regular pointed center, either of which can be used for supporting the cutter arbor. The maximum distance from the face of the column to the bracket is  $11\frac{1}{2}$  in.

A three-step cone pulley is provided as shown on the illustration and the driving belt should be 2 in. wide. The table is 24 in. long by  $5\frac{1}{2}$  in. wide and is unusually thick so as to withstand the strain when clamping on the work. There is a "T" slot  $\frac{1}{2}$  in. wide running from end to end and the table is provided with oil grooves on both sides and an oil pocket on each end.

As stated before, the machine is arranged for both power and hand feed, the power feed mechanism being arranged to give .003 in., .006 in., .009 in., and .012 in. longitudinal travel of the table per revolution of the spindle. It is driven by a 1-in. leather belt, which transmits the power through a four-speed gear box and a universal drive shaft to a worm and gear under the table. An automatic trip releases this worm at the end of the cut.



The Bickett Horizontal Bench Miller

The gears are thoroughly guarded to prevent accidents. The power feed can be changed to hand feed at will, the hand feed being arranged to operate either by means of a geared lever or handwheel.

The screw elevating knee is of the box type, carefully scraped and alined and is held to the column by a substantial adjustable gib. It is raised and lowered by means of an Acme thread elevating screw. The transverse and vertical feeds are both provided with adjustable dials graduated to read in one-thousandth of an inch.

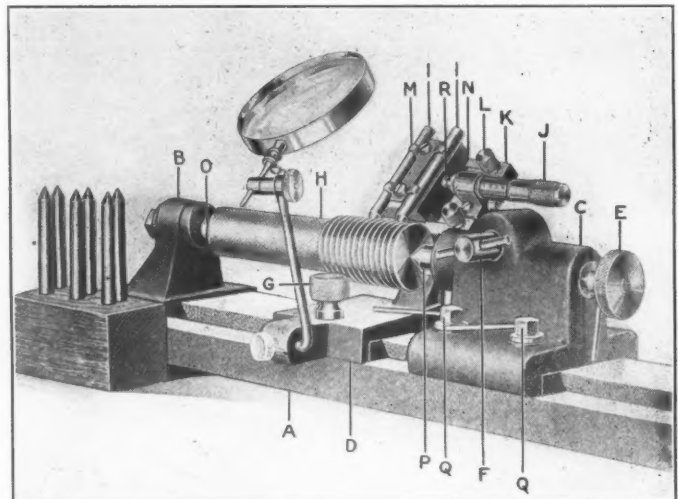
The regular equipment includes a countershaft fitted with 8-in. tight and loose pulleys and the belts are arranged to run close to each side of the tight pulley, thereby making possible a rapid change from one speed to the other. The special equipment includes a 6-in. plain vise, a  $2\frac{1}{2}$ -in.

plain vise, a  $2\frac{1}{2}$ -in. swivel vise, a draw-in. attachment, draw-in collets, a pedestal and a Fulflo pump and piping. The general dimensions of the machine are  $9\frac{1}{2}$  in. by 18 in. by 25 in. high without the pedestal. The capacity of the machine is as follows: Longitudinal feed 16 in., transverse feed 5 in., vertical feed 5 in.

### ANGLE AND LEAD TESTING MACHINE FOR THREAD GAGES

In these days of interchangeable machine parts, where gages are playing so important a role, the thread gage is one of the most difficult to make and to measure accurately, and many mechanics who have attempted the job gave it up for several reasons. One was the difficulty in obtaining machinery accurate enough to do the work and another was the lack of facilities for testing thread gages.

During the last two years, however, there has been considerable improvement in the making of thread gages because engineering societies, large munition concerns and large manufacturing concerns realized that the question of screws, taps and tapped holes in work was one of their most difficult problems. In the manufacture of taps, hobs for hobbing dies, male thread gages and hobs for female thread gages, the question of correct lead and correct angle of the thread was found to be more important even than the correct diameter measurement, and the H. E. Harris Engineering Company, Bridgeport, Conn., has recently designed and constructed



Machine for Testing the Angle and Lead of Screws

machines for testing thread gages which are used successfully in its own shops and by the Bureau of Standards at Washington.

Multiplying gages, even when most carefully made, are prone to inaccuracy due to wear, rust, oil, dirt or other foreign substances, which although infinitesimal in themselves, cause a marked error in reading, due to the multiplying feature. The problem, therefore, was to design a thread gage testing device for the angle and lead which should be rigid and substantial, thoroughly accurate and upon which a very small degree of error might be easily ascertained.

In testing the truth of a flat surface a knife edge straight edge is generally used, as the smallest amount of error, even less than .0001 in. will readily show light between the surface tested and the knife edge, and this principle was embodied in the machine illustrated.

By referring to the illustration which is a general view, it will be noted that the machine consists primarily of a cast iron bed A, stationary head B, with fixed center O and sliding tail block C, which carries spring center P. The compound slide D, very accurately made, is provided with a

micrometer attachment to measure horizontal travel, and the test pieces *I I*, held by a spring clip *M*, are just one inch apart and adjustable in or cut by finger pressure. The set of test pieces shown are ground to different known angles at the point. *H* is a standard thread gage and the magnifying glass is for use on fine work.

*Method of testing lead.*—If the thread gage is standard one-inch, eight-thread, the test pieces will be found to fit accurately into the thread, but if there is a slight error in the pitch, it is simply necessary to withdraw one test piece *I* and move the slider *N* until the other test piece just fits. The amount the slider is moved, as indicated by the micrometer, shows the lead. The same principle applies to larger or smaller threads and to the English or to the metric systems.

*Methods of testing angles.*—In testing angles different test pieces may be tried until one is found that fits the thread or if a standard 60 degree test piece is tried, it will show whether the angle is too large or too small, and whether the cutting tool has been set up square or not. Also such defects as, too large a root diameter or too rounded a top to the thread will show up very plainly. In fact the machine provides an accurate check on thread angle and lead and standard shape.

### WOOD MILLING MACHINE

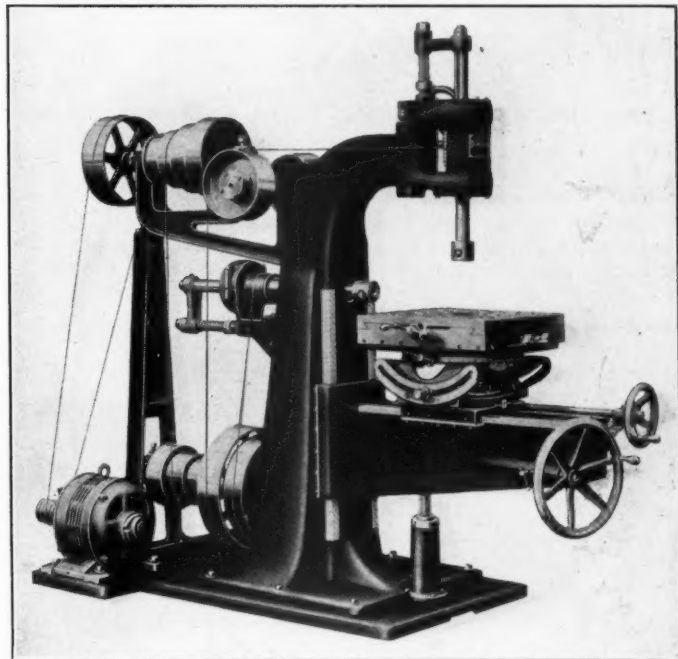
A wood milling machine is to the pattern shop what a universal milling machine is to the tool room. It greatly increases the range of machine operations, thereby eliminating much hand work and resulting in greater accuracy, increased production and greater ease in making duplicate parts. Almost an infinite variety of operations can be performed from cross grooving, trenching and jointing to moiding, mortising and gear cutting.

The wood milling machine illustrated is an improved tool recently placed on the market by the Oliver Machinery Company, Grand Rapids, Mich., and several features make it especially adaptable to railway pattern shop practice. It is made in two sizes, the No. 75 being intended for smaller work and the No. 102 being designed for large shops and heavier work. Referring to the illustration, it will be noticed that the column broadens out rapidly as it nears the large base to which it is bolted, and this insures a substantial machine, practically free from vibration. The knee is of the box type, closed on top to prevent chips interfering with the raising mechanism and open below.

It has a 21-in. travel on the vertical ways and is easily moved by the large hand wheel and square threaded screw.

The table is tapped at convenient locations for attaching the general purpose clamps, and will rotate in a horizontal plane while tipped at any angle up to 45 deg. A positive centering device locates the center directly over the ball bearing swivel center for circular work. The compound cross slides are above the double swivel and tilting mechanism so that the slides operate with the table in any position.

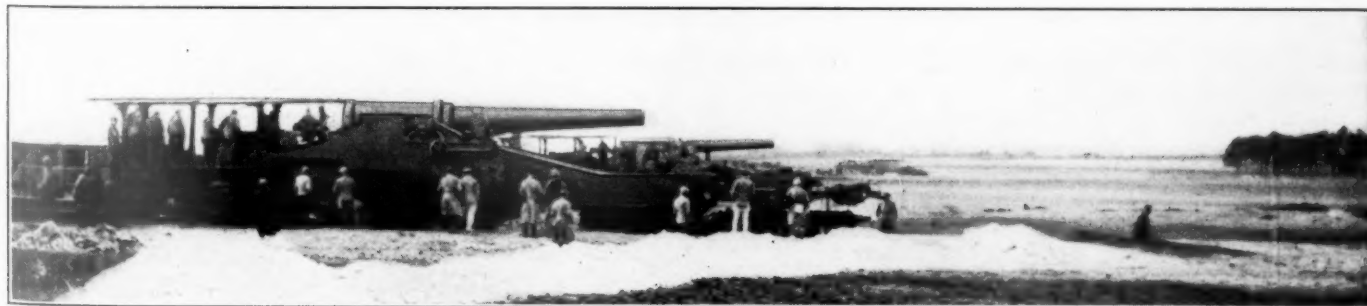
The vertical and horizontal spindles are  $1\frac{7}{8}$  in. in diameter, made of high grade stock accurately ground and supported on ball bearings. The allowable maximum speed is 5,000 r.p.m., and regular speeds usually vary from 1,200 to 4,300 r.p.m. The capacity of the machine is limited only by the size of cutters that can safely be used and the ability of the operator to get the full usefulness out of the machine. Using the vertical spindle, circular work up to 19 in. in diameter may be turned by means of the revolving table. By using the horizontal spindle and revolving



Oliver No. 75 Wood Milling Machine

table, work up to 48 in. in diameter may be turned. A special dividing head permits spur and bevel gears to be accurately cut up to 24 in. in diameter with a 4-in. face. The countershaft runs in babbitt bearings and is an integral part of the machine, being solidly supported from the column and base plate. The countershaft speed is 500 r.p.m. and a 5-hp. motor is recommended for the heavier work. The machine may be driven by a variable or constant speed motor or from line shafting if desired.

A large part of the value of the machine depends upon having a complete assortment of cutters, and an operator who understands how to adjust them quickly and to the best advantage. The company furnishes with the machine an extensive assortment of these cutters for all kinds of ordinary work, and is prepared to make any special cutters that may be required.



Copyright by International Film Service.

A Battery of Big Guns Mounted on Special Railway Carriages

# Railway Mechanical Engineer

(Formerly the RAILWAY AGE GAZETTE, MECHANICAL EDITION  
with which the AMERICAN ENGINEER was incorporated)

PUBLISHED ON THE FIRST THURSDAY OF EVERY MONTH BY THE  
SIMMONS-BOARDMAN PUBLISHING COMPANY

EDWARD A. SIMMONS, President L. B. SHERMAN, Vice-President  
HENRY LEE, Vice-President and Treasurer M. H. WIUM, Secretary  
WOOLWORTH BUILDING, NEW YORK, N. Y.  
F. H. THOMPSON, Business Manager, CHICAGO.

Chicago: Transportation Bldg. Cleveland: Citizens' Bldg.  
Washington: Home Life Bldg.  
London: Queen Anne's Chambers, Westminster.

ROY V. WRIGHT, Editor  
R. E. THAYER, Managing Editor  
C. B. PECK, Associate Editor E. L. WOODWARD, Associate Editor  
A. F. STUERING, Associate Editor C. W. FOSS, Associate Editor

Entered at the Post Office at New York, N. Y., as mail matter of the  
second class.

Subscriptions, including the eight daily editions of the *Railway Age* published in June in connection with the annual convention of the Master Car Builders' and American Railway Master Mechanics' Association, payable in advance and postage free: United States, Canada and Mexico, \$2.00 a year; Foreign Countries (excepting daily editions), \$3.00 a year; Single Copy, 20 cents.

WE GUARANTEE, that of this issue 6,800 copies were printed; that of these 6,800 copies 5,603 were mailed to regular paid subscribers, 128 were provided for counter and news companies' sales, 346 were mailed to advertisers, 167 were mailed to exchanges and correspondents, and 556 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 39,400, an average of 7,880 copies a month.

The RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and of the Audit Bureau of Circulations (A. B. C.).

The output of repaired freight cars at the Kent (Ohio) shops of the Erie was 870 for the month of March, compared with 424 in March, 1917, an increase of over 100 per cent.

Three fires, starting simultaneously in the Lake Erie & Western shops at Lima, Ohio, on April 24, virtually destroyed the \$500,000 plant. From 10 to 14 locomotives, a new train of troop coaches just completed in the shops, and many other coaches and box cars were destroyed.

The United States War Department has ordered for use in France 80 light locomotives, 60-centimeter gage, weighing 35,000 lb., from the Davenport Locomotive Works, also sixty-seven 50-hp. and seventy 35-hp. gasoline locomotives from the George P. Whitcomb Company.

"Get together" meetings are being held in the shops along the entire Erie system in an endeavor to obtain greater co-operation and quick, accurate work in the shops, that the Erie may do its utmost in helping to win the war. Such a meeting was recently held at the Susquehanna shops and several officers of the company, including William Schlafge, general mechanical superintendent, addressed the meeting, urging the men to give their best service.

## Government Orders for Locomotives and Freight Cars

After three weeks of conferences regarding the priority to be given the various activities of the government as to their requirements for steel, an agreement was reached at a conference on April 19 between representatives of the War Industries Board, the Shipping Board and the Railroad Administration, by which the Shipping Board, the Army and the Navy will have priority over the railroads. The Railroad Administration was assured the steel required for the construction of the 2,000 locomotives proposed to be ordered, and for the 100,000 cars, but the car program was required to be changed so as to reduce the quantity of material and especially of steel plates that would be needed.

As a result the all-steel box cars, for which standard specifications were recently adopted, will not be built at this time and less steel than was originally planned for will be used in other types of cars. For example, the 55-ton hopper car will probably be built with wooden sides.

The Railroad Administration has already awarded contracts for 30,000 steel underframe box and coal cars to the American Car & Foundry Company, involving an ag-

gregate outlay of between \$80,000,000 and \$90,000,000 on the basis of cost plus five per cent. Negotiations for 70,000 additional cars are still pending. It is reported that orders have also been placed for about 1,000 locomotives of the standard types.

It is planned to place orders for approximately 100,000 additional cars in about six months.

## Women in Railroad Service

The Pennsylvania Railroad now has in its service 6,513 women, an increase of more than 5,000 since May 1, 1917. The number of females in each of several occupations is given as follows:

Clerks and stenographers.....	3,551	Mechanics' helpers .....	5
Telephone operators .....	778	Painters .....	4
Track laborers .....	293	Hammer operators .....	6
Messengers and assistant messengers .....	192	Turntable operators .....	2
Typists .....	121	Power operators (electrical)...	7
Machine hands .....	29	Coal inspector .....	1
Draftswomen .....	20	Total .....	5,009

The number of women now employed on prominent English roads is given in a recent statement as follows:

London & Northwestern.....	8,392	Northeastern .....	8,520
Great Western .....	6,174	Great Central .....	3,200
Midland .....	9,000	Glasgow & Southwestern.....	1,202

The Midland has increased its forces by 2,700 since last July. Over 1,000 of the women on the Northeastern are employed in the shops, making shells.

## Questionnaire on Equipment Construction and Repair

At the request of the Director General of Railroads the Interstate Commerce Commission has addressed to the railroads a questionnaire asking for complete detailed information relating to repairs to and construction of equipment. Roads are asked to report whether their present shop facilities permit, in addition to properly making all necessary repairs to the present equipment, the construction of new locomotives, freight cars and passenger cars, whether they own or operate under subsidiary companies shops at which locomotives or cars are built or repaired, together with the normal monthly capacity of such shops and the period for which the capacity is engaged on work now in hand or authorized. Information is also desired as to whether it has been the practice to build any portion of the new equipment necessary to replace destroyed or retired locomotives or cars, the present monthly capacity of the shops for the construction

of new equipment by classes, whether all necessary current repairs are made at company shops or by other railroads or at other than railroad shops. If such repairs have been made by other railroads during the past three years information is desired as to the terms under which the work was done. If they have been made by contractors information is requested as to the names of the contractors, the amount of work done and the detailed costs. If the repairs have been performed under express contracts complete information is asked regarding the contracts, prices of materials, labor costs, supervision of work performed, etc., which affect the aggregate costs of the work and will enable a comparison to be made with ordinary railroad shop operations, for the purpose of indicating economy on such repair work. Information is also asked as to repairs made for other railroads.

#### Circulars Issued by the M. C. B. Association

Circulars No. 28 to 33 inclusive, were issued on March 20, by the executive committee of the Master Car Builders' Association.

Circular No. 28 calls attention to the absolute necessity of having all cars equipped with safety appliances by September 1, 1919, and points out that in order to accomplish this it will be necessary and advisable to equip empty foreign cars when passing over the regular freight car repair tracks. The equipment can thus be applied without undue detention to the car. Under the provisions of Rule 33, the repairing line may be reimbursed for the expense of equipping cars with these appliances.

Attention is called in Circular No. 30 to the necessity from the standpoint of safety, that all axles purchased should conform fully to the standards of the association. Axles are being made and offered to railroads which do not conform to the M. C. B. standards. They are made full at the center and hub, but between these two points are under standard size. The circular contains an illustration of the axle in question, that of 100,000 lb. capacity, showing in broken lines the outline of the rough forged axles which are being offered.

In circular No. 32 is announced an extension of the date after which the requirements for the adjustment of hand brake power on tank cars, set forth in circular No. 22, become effective. The extensions are: (1) On new equipment built after July 1, 1918; (2) on existing equipment by January 1, 1921.

#### More Acknowledgments of Tobacco Shipments

Samuel O. Dunn, secretary of the Railway Regiment's Tobacco Fund, has received a letter from R. L. James, first lieutenant and acting adjutant of the Seventeenth Engineers (Railway) Regiment, now in France, dated March 16, acknowledging receipt of a shipment of tobacco which has been distributed among the men. He said in part: "We appreciate very much the kindness of the different railroad organizations who are participating in making these tobacco shipments to the railroad men here in France. The supply of tobacco in France is limited, and for that reason all tobacco received is all the more acceptable. We all thank you very much."

A letter has also been received from Morton Russell, captain adjutant of the Eighteenth Engineers (Railway) Regiment, written by order of Colonel Cavanaugh, acknowledging receipt of three cases which contained twelve 20-lb. packages of tobacco, which have been distributed to the regiment; and expressing the appreciation of the men in that unit.

F. A. Poor, chairman of the Railway Regiments' Tobacco Fund, Chicago, has received acknowledgments of the receipt of shipments of tobacco from three railway regiments in France. Ernest Graves, lieutenant colonel of the Fifteenth

Regiment, U. S. Engineers, writes under date of March 16, that two shipments of tobacco have been received in good condition and distributed to the men. The first shipment contained 240 lb. of Bull Durham and 5 lb. of Tuxedo smoking tobacco and the second shipment contained 540 lb. of Bull Durham and 15 lb. of Lucky Strike. He stated that "There is no doubt but that the men greatly appreciated both shipments."

H. Burgess, colonel of the Sixteenth Engineers Railway Regiment, has written under date of March 12 that the shipment made on December 16 finally reached them although it arrived and was put into the warehouse just a few hours before the latter burned. "The result was that our tobacco was burnt in a fashion different from that intended. One case, however, was rescued and distributed, and all the men very much appreciate the gift."

H. H. Maxfield, lieutenant colonel, commanding the Nineteenth Engineers, Railway Regiment, wrote on March 16 to acknowledge receipt of a shipment of tobacco and stated "The men appreciate this tobacco a great deal more than might be expected, since American troops are entirely dependent upon supplies sent from the States."

#### MEETINGS AND CONVENTIONS

##### *International Railway Supply Men's Association.*—

At a recent meeting of the association at the Hotel Sherman, Chicago, resolutions were passed suspending dues for the year 1918. This action was taken following a request by the International Railway Fuel Association that no exhibit be held at the coming convention of that organization. All entertainment features by the supply association will also be dispensed with.

*Air Brake Association.*—The 25th annual convention of this association will be held in Cleveland, Ohio, May 7 to 10, with headquarters at the Hotel Winton. The work of the convention this year will be directed especially toward greater safety of train movement, less expense of maintenance, and more efficient inspection, with a particular effort to put air brakes in a condition to help the roads through the coming severe winter campaign. The important papers to be presented are as follows: What is the Safe Life of an Air Brake Hose? Recommended Practice of the Air Brake Association, and Conditioning Air Brakes on Freight Trains to Prevent Troubles Enroute.

*Machinery and Tool Convention.*—The enormous problem of manufacturing and supplying machinery and tools sufficient for the carrying out of the government program for the production of ships, shells, guns and aircraft will be the subject considered at the great "War Convention" of the machinery, tool and supply industry of the country to be held in Cleveland the week of May 13. One thousand men who are bearing the brunt of the unprecedented demand for machinery will gather from all parts of the country to lay out a plan, with the aid of government officials, to keep the great munition program going at top speed. The big war convention will be a joint meeting of four great national associations, the American Supply & Machinery Manufacturers' Association, the National Supply & Machinery Dealers' Association, the Southern Supply & Machinery Dealers' Association and the National Pipe & Supplies Association, which will meet together in order to co-ordinate their efforts toward one goal, "More Ships, More Shells."

##### *International Railway General Foremen's Association.*

—It has again been decided by the executive committee of this association to postpone the annual convention. This action was taken in consideration of the great demand for locomotives and cars and the need under present conditions of constant and increased supervision in the railroad

shops. It is the intention to publish the year book, in order to maintain the continuity of the proceedings of the association. The following topics have been selected for the year and the members are requested to write their opinions on the subjects and send them to the secretary. Topic No. 1—What effect has the war had upon your shop methods, and what changes for the better are the results thereof? Topic No. 2—The mileage of a locomotive. Its relation to cost of shop and running repairs. Who should determine when to shop an engine and who should furnish work report? Topic No. 3—Economical and necessary electrical equipment for railroad shops and roundhouses. Topic No. 4—Is the flat rate of pay for various classes of labor a success? Should the minimum rate accepted by various organizations be the maximum rate allowed by employers? How best can greater output by unit of labor be obtained? Topic No. 5—How can a uniform classification of repairs to locomotives be brought about?

**International Railway Fuel Association.**—The 1918 convention of the International Railway Fuel Association will be held in Chicago on May 23 and 24. The program for the convention, as tentatively outlined, is as follows:

Introductory address, E. W. Pratt, president International Railway Fuel Administration.

The Fuel Problem in the War, H. A. Garfield, U. S. Fuel Administrator.  
The Railroads and their Relation to the Fuel Problem, C. R. Gray, Director Division of Transportation, United States Railroad Administration.  
What Can be Done for Our Northern Ally, Sir George Bury, chairman, Canadian Railways War Board.

The Need for Fuel Conservation, P. B. Noyes, Director Conservation Division, U. S. Fuel Administration.

The Coal Operator and His Responsibilities in the Fuel Situation, Edwin Ludlow, vice-president, Lehigh Coal and Navigation Co., Lansford, Penn.  
What the Men on the Locomotives Can Do, W. S. Stone, grand chief, Brotherhood of Locomotive Engineers.

What the Coal Miner Can Do to Help the Government, the Railroads and the Men at the Front, John P. White, Labor Advisor, U. S. Fuel Administration.

The Motive Power Department and Fuel Economy, R. Quayle, general superintendent, Motive Power and Car Department, Chicago & North Western.

What the Coal Operator Can Do to Help Win the War, H. N. Taylor, vice-president, Central Coal & Coke Company, Kansas City.

The Railroad Industrial Army—a Component Part of the American Expeditionary Force and the Allied Armies, W. S. Carter, Director, Division of Labor, United States Railroad Administration.

The Supply and Distribution of Fuel, J. D. A. Morrow, Director, Distribution Division, U. S. Fuel Administration.

Relation of Locomotive Maintenance to Fuel Economy, Frank McManamy, Director, Division Locomotive Maintenance, United States Railroad Administration.

The Transportation Department and Fuel Economy, E. H. De Groot, Jr., Assistant Manager, Car Service Section, Division of Transportation, U. S. Railroad Administration.

More and Better Coal, Eugene McAuliffe, president, Union Colliery Company, St. Louis.

*The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:*

**AIR BRAKE ASSOCIATION.**—F. M. Nellis, Room 3014, 165 Broadway, New York City. Convention May 7 to 10, 1918, Cleveland, Ohio.

**AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.**—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

**AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.**—J. W. Taylor, Karpen Bldg., Chicago.

**AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.**—R. D. Fletcher, Belt Railway, Chicago.

**AMERICAN SOCIETY FOR TESTING MATERIALS.**—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa. Annual meeting June 25-28, 1918, Hotel Traymore, Atlantic City, N. J.

**AMERICAN SOCIETY OF MECHANICAL ENGINEERS.**—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

**ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.**—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

**CAR FOREMEN'S ASSOCIATION OF CHICAGO.**—Aaron Kline, 841 Lawlor Ave., Chicago. Second Monday in month, except June, July and August, Hotel Morrison, Chicago.

**CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.**—W. R. McMunn, New York Central, Albany, N. Y.

**INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.**—A. L. Woodworth, C. H. & D., Lima, Ohio.

**INTERNATIONAL RAILWAY FUEL ASSOCIATION.**—J. G. Crawford, 547 W. Jackson Blvd., Chicago. Convention May 23 and 24, Chicago.

**INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.**—William Hall, 1126 W. Broadway, Winona, Minn.

**MASTER BOILERMAKERS' ASSOCIATION.**—Harry D. Vought, 95 Liberty St., New York.

**MASTER CAR BUILDERS' ASSOCIATION.**—J. W. Taylor, Karpen Bldg., Chicago.

**MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.**—A. P. Dane, B. & M., Reading, Mass.

**NIAGARA FRONTIER CAR MEN'S ASSOCIATION.**—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

**RAILWAY STOREKEEPERS' ASSOCIATION.**—J. P. Murphy, Box C, Collinwood, Ohio.

**TRAVELING ENGINEERS' ASSOCIATION.**—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio. Next meeting, September 10, 1918, Chicago.

## PERSONAL MENTION

### GENERAL

**W. I. CANTLEY**, assistant mechanical engineer of the Lehigh Valley, with office at South Bethlehem, Pa., has been appointed mechanical engineer.

**FRANK A. DEWOLFF**, master mechanic at the Sagua-la-Grande (Cuba) shops of the Cuban Central, has been appointed assistant superintendent of locomotives, with office at the same place.

**H. K. FOX**, chief draftsman in the motive power department of the Western Maryland at Hagerstown, Md., has been appointed engineer of tests of the Chicago, Milwaukee & St. Paul, with headquarters at Milwaukee, Wis., succeeding W. T. Bennison, resigned.

**G. G. GILPIN**, chief draftsman of the mechanical department of the Chicago, Burlington & Quincy, has resigned to accept service with another company.

**O. R. HALE**, assistant superintendent of locomotives of the Cuban Central with office at Sagua-la-Grande, Cuba, has been appointed superintendent of locomotives, with headquarters at the same place.

**H. E. HINES**, draftsman in the office of the mechanical engineer, of the Chicago, Burlington & Quincy, has been appointed mechanical engineer of the Colorado & Southern, succeeding E. C. Anderson.

**E. E. RAMEY**, assistant terminal trainmaster of the Baltimore & Ohio at Philadelphia, Pa., has been appointed superintendent of fuel consumption, succeeding W. L. Robinson. Mr. Ramey was born on March 27, 1883, in Scott county, Va., and is a graduate of the University of Kentucky, with a degree of M. E. In October, 1904, he became an assistant engineer of dynamometer tests in the railway department of the International Correspondence Schools and was subsequently made superintendent of tests for that company, conducting dynamometer tests on various railroads. From September, 1910, to July, 1911, he acted



E. E. Ramey

as assistant engineer of dynamometer tests for the Baltimore & Ohio, the Delaware, Lackawanna & Western, the Canadian Pacific and the Chesapeake & Ohio. In October, 1911, he was assigned to tonnage work on the Baltimore & Ohio, and made special studies and reports to the operating vice-president. From June, 1916, to January, 1917, he was general inspector of maintenance and then was engineer of material conservation to July, 1917, when he was appointed assistant terminal trainmaster at Philadelphia.

**E. G. JOHNSON**, general master mechanic of the Chicago, Burlington & Quincy, with headquarters at Lincoln, Neb., has been appointed assistant superintendent of motive power at Lincoln, and his former position has been abolished.

**T. E. KEYWORTH**, superintendent of locomotives on the Cuban Central, with office at Sagua-la-Grande, Cuba, has been appointed assistant general manager with headquarters at the same place.

**M. J. POWERS**, master mechanic of the Denver & Rio Grande, Colorado lines, with headquarters at Denver, Colo., has been appointed superintendent of motive power of the Colorado Midland, with office at Colorado Springs, Colo.

**JOHN L. SMITH**, master mechanic of the Pittsburg, Shawmut & Northern, with office at St. Mary's, Pa., has been appointed superintendent of motive power and equipment, and his former position has been abolished.

**H. S. WALL**, superintendent of shops of the Atchison, Topeka & Santa Fe Coast Lines, at San Bernardino, Cal., has been appointed mechanical superintendent, with headquarters at Los Angeles, Cal., succeeding S. L. Bean, deceased.

**W. R. WOOD**, mechanical engineer of the Great Northern, St. Paul, Minn., has been appointed mechanical engineer on the staff of Ralph Budd, assistant in charge of capital expenditures to the regional director of western railroads, and is located in Chicago.

**W. H. WINTERROWD**, whose appointment as chief mechanical engineer of the Canadian Pacific, with headquarters at Montreal, Que., was noted in these columns last month, was born on April 2, 1884, at Hope, Ind. He attended the public schools at Shelbyville, Ind., and graduated in 1907 from Purdue University. In 1905 he was employed for a short time as a blacksmith's helper on the Lake Erie & Western at Lima, Ohio, and in 1906 he was a car and air brake repairman on the Pennsylvania Lines West at Dennison, Ohio. After graduation he became a special apprentice on the Lake Shore & Michigan Southern, and in 1908 he went with the Lake Erie, Alliance & Wheeling as enginehouse foreman at Alliance, Ohio. In 1909 he became night enginehouse foreman of the Lake Shore & Michigan Southern at Youngstown, Ohio, and in 1910 was made roundhouse foreman at Cleveland. Later in the same year he was promoted to assistant to the mechanical engineer of the Lake Shore. Since September, 1912, he has been with the Canadian Pacific at first as mechanical engineer and in May, 1915, was appointed assistant chief mechanical engineer.



W. H. Winterrowd

#### MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

**FLOYD BEATTY** has been appointed supervisor of locomotive operation of the Erie, with office at Port Jervis, N. Y.

**M. G. BROWN**, master mechanic of the Wrightsville & Tennille, with headquarters at Tennille, Ga., has resigned that position to enter the service of the Georgia, Florida & Alabama, with headquarters at Bainbridge, Ga.

**S. C. CARLOUGH** has been appointed supervisor of locomotive operation of the Erie, with office at Secaucus, N. J.

**J. A. CONLEY**, master mechanic of the Atchison, Topeka & Santa Fe at Raton, N. M., has been transferred to the Valley division, with headquarters at Fresno, Cal., succeeding John Pullar, transferred.

**EDWARD G. KLEINKAUF**, general foreman of the Lehigh Valley at South Easton, Pa., has been promoted to master mechanic at Sayre, Pa., succeeding J. P. Laux. Mr. Kleinkauf was born at Wilkes-Barre, Pa., on April 21, 1874, and received his education in the public schools. Starting in November, 1890, as an engine wiper on the Lehigh Valley, he has since served that road continuously in various capacities, with the exception of a period of time from February, 1902, to May, 1903, when he was employed by the Delaware, Lackawanna & Western as a machinist at Scranton, Pa. In November, 1907, he was appointed annex and enginehouse foreman of the Lehigh Valley at Sayre, Pa.; in September, 1913, general foreman at Hazleton; in December, 1915, enginehouse foreman at South Easton, and in February, 1916, general foreman at that point.

**J. P. LAUX**, master mechanic of the Lehigh Valley, with office at Sayre, Pa., has been transferred to South Easton, Pa., succeeding D. D. Robertson, resigned.

**JOHN PULLAR**, master mechanic of the Atchison, Topeka & Santa Fe Coast Lines at Fresno, Cal., has been transferred to the Los Angeles division, with headquarters at San Bernardino, Cal., succeeding A. B. Armstrong.

**W. A. RANDOW** has been appointed master mechanic of the First division of the Denver & Rio Grande, with headquarters at Pueblo, Colo., with jurisdiction over the entire division, with the exception of Burnham shops, succeeding M. J. Powers, resigned, and the office of assistant master mechanic has been abolished.

**A. L. ROBERTS**, mechanical engineer of the Lehigh Valley, has been promoted to master mechanic, with office at Wilkes-Barre, Pa., succeeding M. R. Smith, resigned.

#### SHOP AND ENGINEHOUSE

**A. B. ARMSTRONG**, master mechanic of the Atchison, Topeka & Santa Fe Coast Lines, at San Bernardino, Cal., has been appointed superintendent of shops, succeeding H. S. Wall, with the same headquarters.

**W. M. HARDING** has been appointed general foreman of the Cincinnati, New Orleans & Texas Pacific at Oakdale, Tenn., succeeding D. H. Andrews.

**G. A. HILLMAN** has been appointed shop demonstrator at the Meadville shops of the Erie.

**HENRY REIFF** has been promoted to machine shop foreman of the Erie at Marion, Ohio, succeeding J. Strawser.

#### CAR DEPARTMENT

**T. J. BELL** has been appointed superintendent foreman of the car department of the Erie at Cleveland, Ohio, succeeding G. Egan, resigned.

#### PURCHASING AND STOREKEEPING

**G. H. ROBISON**, general storekeeper of the Oregon Short Line, with office at Pocatello, Idaho, has been appointed acting purchasing agent in addition to his duties as general storekeeper, with headquarters at Salt Lake City, Utah, succeeding A. E. Hutchinson, deceased.

#### COMMISSION APPOINTMENT

**GARLAND P. ROBINSON**, assistant chief inspector of locomotives for the Interstate Commerce Commission, has been appointed assistant manager of the locomotive section of the Railroad Administration.

## SUPPLY TRADE NOTES

The Maloney Oil & Manufacturing Company has removed its New York office from 50 Church street to 17 Battery place

The Grip Nut Company moved its offices from the McCormick building, Chicago, to the Railway Exchange building, on May 1.

N. M. Garland, of New York, district manager for the Ohio Brass Company, has been elected a member of the board of directors of that company.

P. L. Maher, business manager of the Eastern Car Company, Limited, of New Glasgow, N. S., has been appointed assistant to the president of the Damascus Brake Beam Company, Cleveland, Ohio. Mr. Maher will specialize on shop operation and efficiency.

Major Warren R. Roberts, Quartermaster's Reserve Corps, president of the Roberts & Schaefer Company, Chicago, has been promoted to lieutenant-colonel. At present he is an executive officer for the constructing branch of the construction division of the United States Army.

The Liberty Car & Equipment Company, 20 West Jackson boulevard, Chicago, has been incorporated with P. H. Joyce as president, and has bought the freight car plant of the Central Locomotive & Car Works, Chicago. The locomotive plant of the latter is being utilized for the manufacture of farm tractors.

Rufus Franklin Emery, secretary and treasurer of the Westinghouse Air Brake Company, died suddenly on April 11, in his office at Wilmerding, Pa. He was born in 1869 at Chatham, Mass., and was educated in the grammar and high schools of his native town. He entered business life at an early age and after service with several business interests in the Pittsburgh district, entered the employ of the Westinghouse Air Brake Company in September, 1892, where he held various positions of trust and responsibility, until 1909 when he was elected secretary and treasurer. At the time of his death, Mr. Emery was an officer and director in a number of business and financial institutions in the Pittsburgh district.



R. F. Emery

Paul W. Wendt of the P. W. Wendt Company, railway supplies, Chicago, has been appointed assistant production manager in charge of steel, of the Emergency Fleet Corporation, United States Shipping Board, in the Chicago district, comprising Michigan, Indiana, Illinois, Wisconsin, Minnesota and Iowa.

The International Oxygen Company, 115 Broadway, New York, announces the appointment of A. E. Ward as sales manager. Mr. Ward was formerly associated with the Prest-O-Lite Company, and in the course of years of association with the compressed gas industries has gained

recognition as an expert in the industrial applications of oxygen, hydrogen and acetylene.

M. F. Emrich, formerly of the Glidden Company, Cleveland, Ohio, has been appointed assistant general manager for Berry Brothers, Detroit, Mich. Mr. Emrich was with the Glidden Company for 28 years, having filled various positions, from the bottom up to the position of assistant to the president. He began his services with Berry Brothers on April 1.

Clyde P. Benning, assistant to the vice-president of Mudge & Co., Chicago, has been appointed western manager, with office in the Crocker building, San Francisco, Cal., in charge of the business of that company in the Pacific Coast states. Mr. Benning was born in Atchison, Kan., on September 20, 1888, and was educated in the public schools of that city. In 1903 he entered the service of the Missouri Pacific and held positions as messenger in the chief despatcher's office, telegraph operator and freight office and yard clerk. In 1904 he was employed as time-keeper in the master mechanic's office of this road, remaining in that position until April, 1905, when he entered the Missouri Pacific shops as machinist apprentice, later being promoted to machinist. He left the road in 1910 to accept a position with the Tool & Railway Specialty Company at Atchison, remaining with that concern until December 15, 1914, when he entered the service of Mudge & Co. as shop inspector. He was soon after appointed chief inspector and subsequently held the position of service engineer. In 1916 he was made assistant to the vice-president, which position he held until his appointment as western manager, as noted above.



C. P. Benning

The Schroeder Headlight Company, Evansville, Ind., manufacturers of locomotive oil and electric headlights and turbo generators, has been purchased by W. A. Carson, vice-president and general manager of the Evansville (Ind.) Railways, the Owensboro (Ky.) City Railroad and the Henderson (Ky.) Traction Company, and a number of associates, some of them interested with him in the Evansville Railways. A new company known as the Schroeder Headlight & Generator Company has been organized with Mr. Carson as active vice-president and general manager. Mr. Carson has been connected with the Evansville Railways since July, 1908. He was assistant to the general superintendent of the Indianapolis & Cincinnati Traction Company from 1903 to 1906, and assistant general manager of the Indianapolis, Columbus & Southern Traction Company from 1906 to 1908. Since his connection with the Evansville Railways the company has constructed a number of interurban connections and through a syndicate of the officers of that company, of which Mr. Carson was a member, has purchased the city lines of Henderson and Owensboro, Ky. In 1912 a lease was secured on the line of the Illinois Central Railroad between Evansville and Henderson and this property was electrified by the Evansville Railways. A gasoline car ferry was installed to transfer the interurban cars across the river. In 1913 the Crescent Navigation Company was in-

corporated with Mr. Carson as president to operate on the Ohio river in connection with the railway properties. Mr. Carson retains his connection as vice-president and general manager of the Evansville Railways in an advisory capacity and will continue as president of the Crescent Navigation Company.

#### Carnegie Steel Company Changes

As previously announced in these columns, Colonel Henry P. Bope has resigned his position as vice-president and general manager of sales with the Carnegie Steel Company to devote his time to private interests.



Col. H. P. Bope

Colonel Bope was born and educated at Lancaster, Ohio, and devoted himself at first to stenographic reporting in the Ohio legislature. In November, 1879, he became connected with Carnegie Brothers & Co., and has remained continuously in the sales work of that company and its successors up to the present time. His period of service has thus covered the wide expansion of the use of steel and the

growth of great commercial and business organizations, in all of which he has had a most active part.

He has been succeeded in his office with the Carnegie Steel Company by William G. Clyde.



W. G. Clyde

Mr. Clyde was educated in the Pennsylvania Military College, at Chester, Pa. He first entered the employ of Ryan & McDonald, contractors of Baltimore, Md., was then associated with Robert Wetherill & Co., machinists and founders, and was later superintendent of the plate mills of the Wellman Steel & Iron Company, in Thurlow, Pa. His connection with the United States Steel Corporation and its subsidiaries dates from 1894 when he became superintendent of the plate mills of the Illinois Steel Company at South Chicago. On the formation of the American Steel Hoop Company he became traveling salesman for that company in Chicago, and five months later was made manager of sales at Philadelphia, where he remained until 1902, when, after the formation of the United States Steel Corporation, the American Steel Hoop Company was merged with the Carnegie Steel Company. For the next three years Mr. Clyde was traveling salesman for the Carnegie Steel Company at Cleveland, Ohio. In September, 1905, he was made assistant general manager of sales at Pittsburgh in charge of the bureau of bars and hoops, which office he retained until his present promotion. Mr.

Clyde by the promotion has also become a member of the board of directors of the company.

Charles L. Wood, long assistant to Mr. Clyde, has been promoted to be assistant general manager of sales in charge of the bureau of bars and hoops. Mr. Wood was born in Youngstown, Ohio, in the atmosphere of iron and steel manufacture. He was educated as a mining engineer at the Ohio State University, and his first employment was with the Calumet Furnace Company, of Chicago, as chemist, followed by several years' experience in the practice of mining engineering in Colorado and the West. Mr. Wood became associated with the American Steel Hoop Company on its formation, first in the order department. On the merging of the Hoop Company with the Carnegie Steel Company his abilities caused his transfer to the sales department in charge of the bureau of bars and hoops. His promotion comes as a logical recognition of his large experience in the sale of bar mill products and his wide acquaintance with their users.

H. A. Jackson, sales agent of the Bethlehem Steel Company at Boston Mass., has been elected president of the Chicago Pneumatic Tool Company, with office at Chicago, succeeding W. O. Duntley, resigned.



H. A. Jackson

Mr. Jackson was born in Bethlehem, Conn., on July 7, 1881. He is a graduate of the Lawrence Scientific School of Harvard University, class of 1903, but devoted an additional year to a special course in metallurgical work in the graduate school there. Mr. Jackson entered the employ of the Bethlehem Steel Company in July, 1904, where he served an apprenticeship in the various departments of

the works, thus gaining practical experience and an intimate acquaintance with the steel business by personal contact with the production end. He later entered the sales department of the Bethlehem organization. A number of years ago Mr. Jackson was sent to Boston to open the Bethlehem Steel Company's office there and to organize its sales and executive forces in that territory. He continued in the position of sales agent at Boston until his election as president of the Chicago Pneumatic Tool Company at a special meeting of the board of directors held in New York on April 19. He is not an entire stranger in Chicago, where he now has his headquarters, as he was sales agent in that city for the Bethlehem company for several months early in his career.

The Youngstown, Ohio, office of the H. W. Johns-Manville Company is now located at 520 Market street. The same company has also found it necessary, owing to increased business on the Pacific coast, to open new offices at Tacoma, Wash. The office will be located at 1015 A street and will carry a complete stock of Johns-Manville products.

The Abell-Howe Company, 332 South Michigan avenue, Chicago, has been appointed representative of the Standard Malleable Iron Company, Muskegon, Mich., for the sale of malleable castings through its several offices located at Chicago, Pittsburgh, Cleveland and New York. The company has also been appointed representative of the Northern Engineering Works, Detroit, Mich., builders of electric overhead traveling cranes, electric hoists and foundry

equipment, for the sale of these products in the territory tributary to Chicago.

D. B. Clark, who was formerly superintendent of the shell department of the American Brake Shoe & Foundry Company at Erie, Pa., is now general superintendent of the Watervliet arsenal, Watervliet, N. Y. This arsenal is the largest and oldest arsenal in the United States and Mr. Clark has charge of the entire production of this plant.

George W. Bender, assistant to the vice-president of Mudge & Company, Chicago, has been appointed eastern manager, with office at 30 Church street, New York. Mr. Bender was born at Pittsburgh, Pa., on August 20, 1884, and at the age of 17 entered the engineering department of the Pressed Steel Car Company, of that city. In 1906 he accepted a position with the American Locomotive Company, where he had charge of the extra work order department. In 1910 he became associated with Mudge & Co. as chief draftsman, and subsequently was given charge of the mechanical department. Later on he was made assistant to the vice-president, a position he held until his appointment as eastern manager in charge of the business of Mudge & Co. in the New England and Atlantic Coast states.

Charles J. Donahue, formerly assistant vice-president in charge of sales of the American Locomotive Company, died at his home in New York on April 20, after a long illness. Mr. Donahue was the son of a locomotive engineer. He was born at Cleveland, Ohio, on March 8, 1871. His first position in railway service was in the motive power department of the Lake Shore & Michigan Southern at Cleveland. Here he showed marked ability and was rapidly promoted. He served successively as chief clerk to the superintendent of motive power of the Lake Shore under G. W. Stevens, W. H. Marshall and H. F. Ball, and as chief clerk to W. H. Mordue, general manager. From there he was called to Chicago as chief clerk to C. E. Schaff, vice-president of the Lake Shore. In September 1, 1908, he was appointed secretary to W. H. Marshall, president of the American Locomotive Company, and two years later was appointed assistant vice-president in charge of sales, which position he held up to July, 1917. He retired from the American Locomotive Company to form a company to handle railroad supplies, but ill health prevented the accomplishment of this purpose.



G. W. Bender



C. J. Donahue

## CATALOGUES

**FLANGE LUBRICATOR.**—The economies resulting from a proper distribution of oil to the driving wheel flanges are pointed out in Circular No. D4, called "Flange Lubrication," issued by the Swanson Automatic Flange Lubricator Company, Denver, Colo. Common car or black oil gives the best results with the Swanson lubricator, which is of the automatic type, depending for its action on engine vibration.

**HEATING APPLIANCES.**—The Macleod Company, 213 East Pearl street, Cincinnati, Ohio, has issued Buckeye Catalogue E, describing several appliances now manufactured by the company, which use crude oil in the heating of locomotive parts. These appliances include a Buckeye flood light, locomotive fire kindler, paint sprayer, locomotive tire heater and several kinds of furnaces. The Buckeye oxy-acetylene welding outfit is also illustrated.

**SELF-OPENING DIES.**—A booklet entitled "Wells Self-Opening Dies" has been issued recently by the Greenfield Tap & Die Corporation, Greenfield, Mass. It contains a detailed description and illustration of the self-opening die manufactured by that company and shows the tool to be very serviceable and adaptable to widely varying conditions. The different kinds of tripping arrangements, including the pull trip, rim trip, face and lever trip are illustrated.

**HEAT INSULATION.**—The Magnesite Association of America, with offices at 702 Bulletin building, Philadelphia, Pa., has issued a large, well illustrated portfolio showing the many places in which it is necessary to use heat insulating material in order to save fuel. All statements in this portfolio regarding the value of "85 per cent Magnesite" as a covering for steam pipes and boilers are vouched for by the Mellon Institute of Industrial Research, University of Pittsburgh.

**PIPE TOOLS.**—Catalogue 38, entitled "Pipe Tools" and issued by the Greenfield Tap & Die Corporation, Greenfield, Mass., shows the complete line of pipe tools made by this corporation. The quick release and quick return features of the Greenfield receding pipe threader are emphasized and the catalogue contains an extensive list of stocks and dies, burring reamers, pipe cutters and wrenches. The back of the catalogue contains considerable useful information and several tables.

**MOTOR DRIVEN COMPRESSORS.**—The Westinghouse Traction Brake Company, Pittsburgh, Pa., has issued a high grade, finely illustrated booklet describing in detail its complete line of motor driven air compressors, both stationary and portable, ranging in capacity from 11 to 110 cu. ft. Compressed air accessories for doing almost every possible kind of work are included. Users of compressed air tools will find many new features and valuable labor-saving devices in this book, which is designated as publication No. 9035 and has been copyrighted.

**CAR INSULATION.**—The Union Fibre Company, of Winona, Minn., has issued a booklet entitled, "Insulation of Railway Equipment" which takes up in considerable detail the insulation of refrigerator and other cars. The front of the booklet contains an interesting account of the beginning and evolution of the refrigerator car and a development of the theory of insulation. Further on a description is given of the manufacture of Linofelt which is composed, mostly of flax fibre and is a good insulator. The back of the booklet is devoted to the discussion of a series of actual tests, conducted in 1908 by several railroads, with a view to determining the best practice in refrigerator car construction.